DOCUMENT RESUME

ED 155 072 SO 010 797

TITLE	An Analysis of Federal R & D Funding by Function, Fiscal Years 1969-1978. Survey of Science Resources Series.
INSTITUTION	National Science Foundation, Washington, D.C.
REPORT NO	NSF-77-326
PUB DATE	Oct 77
NOTE	157p.; Not available in hard copy due to small type size and use of color in many charts; For a related document, see ED 135 635
AVAILABLE FROM	Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Stock No. 038-000-00356-9, $2.75, paper cover)
EDRS PRICE	MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS	Budgeting; Budgets; *Cost Indexes; Data Analysis; Energy; Environmental Research; Expenditures; *Federal Aid; Federal Programs; *Financial Support; Government Role; Longitudinal Studies; National Defense; Research Criteria; Research Needs; *Research Projects; Social Problems; Space Sciences; *Statistical Analysis; Tables (Data); Trend Analysis

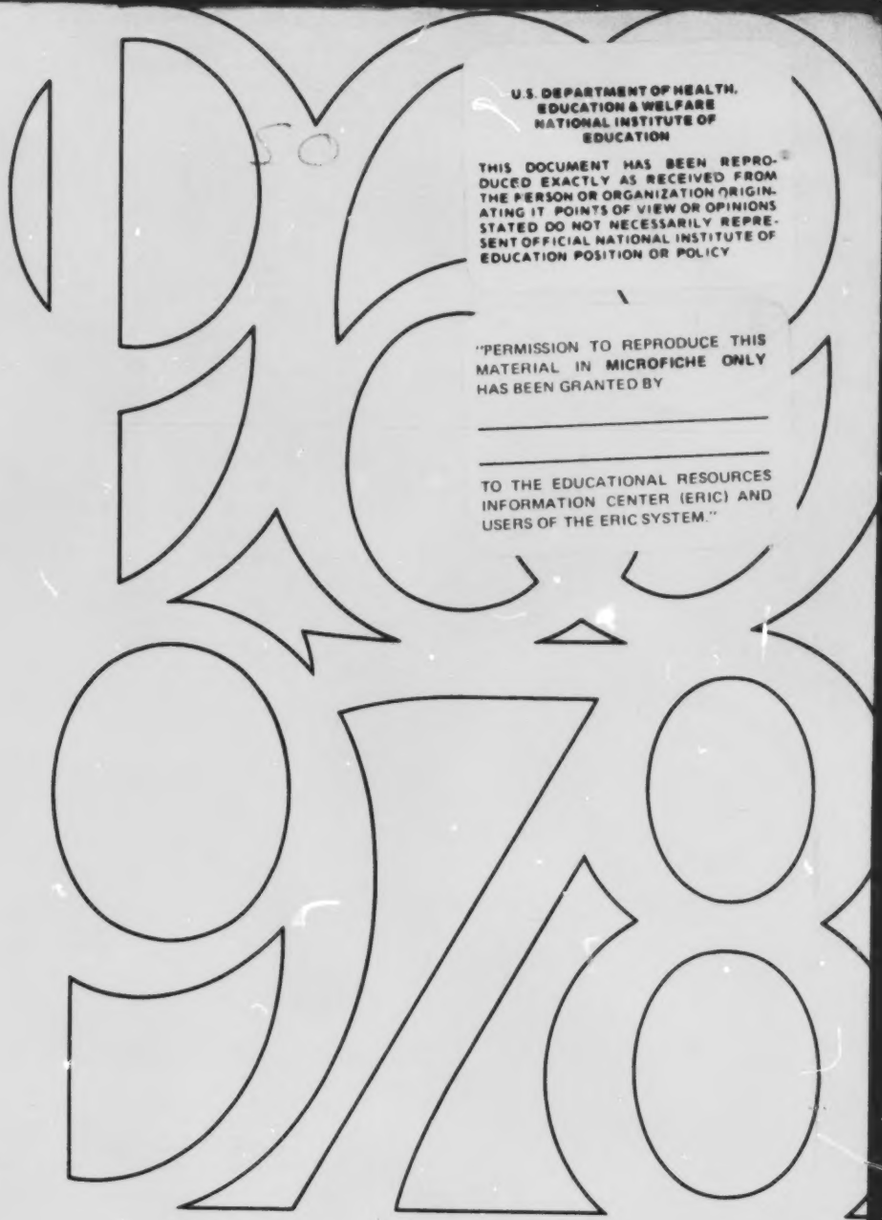
ABSTRACT

Because U.S. government expenditures for research and development (R & D) comprise more than half of the total national support in these areas, the government plays the major role in determining the nature and objectives of R & D efforts. This report examines the federal response to national needs in terms of R & D support and changing R & D priorities. There are two major parts to the report. In part I, federal R & D priorities are identified in order of financial expenditures in 1977. They are national defense, space, energy, health, environment, science and technology, transportation and communication, natural resources, agriculture, education, social services, economic growth, international development, and crime prevention. Part II explains federal R & D functions in detail. A review of the federal budget shows that R & D obligations were an estimated $24.5 billion in fiscal year 1977, representing an average annual growth rate of 5.8% since 1969. The six leading R & D functional areas (defense, space, energy, health, environment, and science and technology) have been the focus of most of the recent growth. Between 1969 and 77, a sharp rise occurred in the emphasis on civilian R & D programs. During this period the defense/space share of the federal R & D total dropped from 77% to an estimated 61%, while civilian R & D programs grew from 23% to an estimated 39%. An appendix presents technical notes and statistical tables. (Author/DB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED155072

Fiscal Years



U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

SP010 017

An Analysis of Federal R&D Funding by Function

Survey of Science Resources Series • National Science Foundation • NSF 77-326

Related Publications

REPORTS	NSF No.	Price
Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1976, 1977, and 1978, Volume XXVI	78-300	In press
Detailed Statistical Tables	77-317	—
National Patterns of R&D Resources: Funds and Manpower in the United States, 1953-1977	77-310	$1.50
An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1977	76-325	$2.45
HIGHLIGHTS		
"Defense and Energy Spur Federal R&D Growth from FY 1974 to FY 1978"	77-320	—
"Federal R&D Funding Shows Strong Recent Rise but Little Real Growth in FY 1978"	77-323	—

Availability of Publications

Those publications marked with a price should be obtained directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Where no price is listed, single copies may be obtained gratis from the National Science Foundation, Washington, D.C. 20550.

(See inside back cover for Other Science Resources Publications)

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 – Price $2.75

Stock Number 038-000-00356-9

FOREWORD

The expenditure of Federal R&D funds affects national security, economic welfare, industrial capabilities, and more broadly, the overall quality of life. More than one-half of the national R&D effort is supported with Federal funds, and thus the Federal Government plays the major part in determining the nature of the national R&D effort and the impact of that effort on national objectives. This effort, however, is many-sided. Over the past decade, the amount and direction of Federal R&D programs have been influenced by the emergence of national problems such as the energy crisis, the deterioration of the environment, food production deficiences, and continuing concern in such vital areas as national defense and health. Therefore, the need exists to examine Federal R&D support on a functional basis.

Between 1969 and 1978 an outstanding feature of such support has been the sharp rise in emphasis on civilian R&D programs as compared with those for defense and space. In 1969 the defense/space share accounted for three-fourths of the Federal R&D effort; in 1978 the share is estimated to be about three-fifths. Since 1974, however, defense R&D programs have shown a strong and steady rise and those of space, a moderate increase. Keeping pace with these defense/space increases, however, are a sharp growth in energy R&D funding and a more gradual but significant growth in other civilian areas.

The purpose of the present report is to provide a perspective on the Federal response to a range of national needs in terms of R&D support and to show changing R&D priorities. This report has evolved from a function analysis series that began in 1971 and that included a report each year thereafter. The chief value of a continuing analysis of this nature lies in the opportunity it provides to study shifts in emphasis among national R&D priorities over a period of years.

Harvey Averch
Assistant Director
Scientific, Technological, and
International Affairs

October 1977

notes

The data for 1976-78 shown in appendix table B and the text tables were collected from the agencies in March and April 1977 and are based on agency budgets as incorporated in the President's budget message. The 1978 data reflect requests for fiscal year 1978 and thus do not reflect subsequent congressional appropriations or changes made by Executive apportionment. Fiscal year 1977 data represent obligations estimated in the second quarter of fiscal year 1977 and include both appropriated funds and funds carried over from prior years. R&D support levels shown in the tables represent both program costs and administrative costs.

Table and chart details may not add to totals because of rounding.

Significant changes in 1978 program amounts resulting from congressional actions taken at the time this report was prepared are noted in the text.

method

The 15 functions and 32 subfunctions in this report were chosen to make visible the most important R&D objectives in the 1978 budget. Data are additive to 100 percent, and thus each program can only appear under the function that embraces its primary purpose and not under headings that relate to secondary purposes.

acknowledgments

This report was prepared in the Division of Science Resources Studies under the general guidance of Charles E. Falk, Director, and William L. Stewart, Head, R&D Economic Studies Section. Benjamin L. Olsen, Study Director, Government Studies Group, provided direction. Jane Pugh was responsible for aggregating the data and preparing the appendix table. Eleanor Stoddard was responsible for organizing the report and for writing the text with the assistance of Benjamin Stoner. Dorothy K. Ham prepared statistical material and graphic illustrations.

CONTENTS

Highlights vii

Introduction viii

Part I. Federal R&D Priorities by Function 1

Part II. Functions in Detail* 11

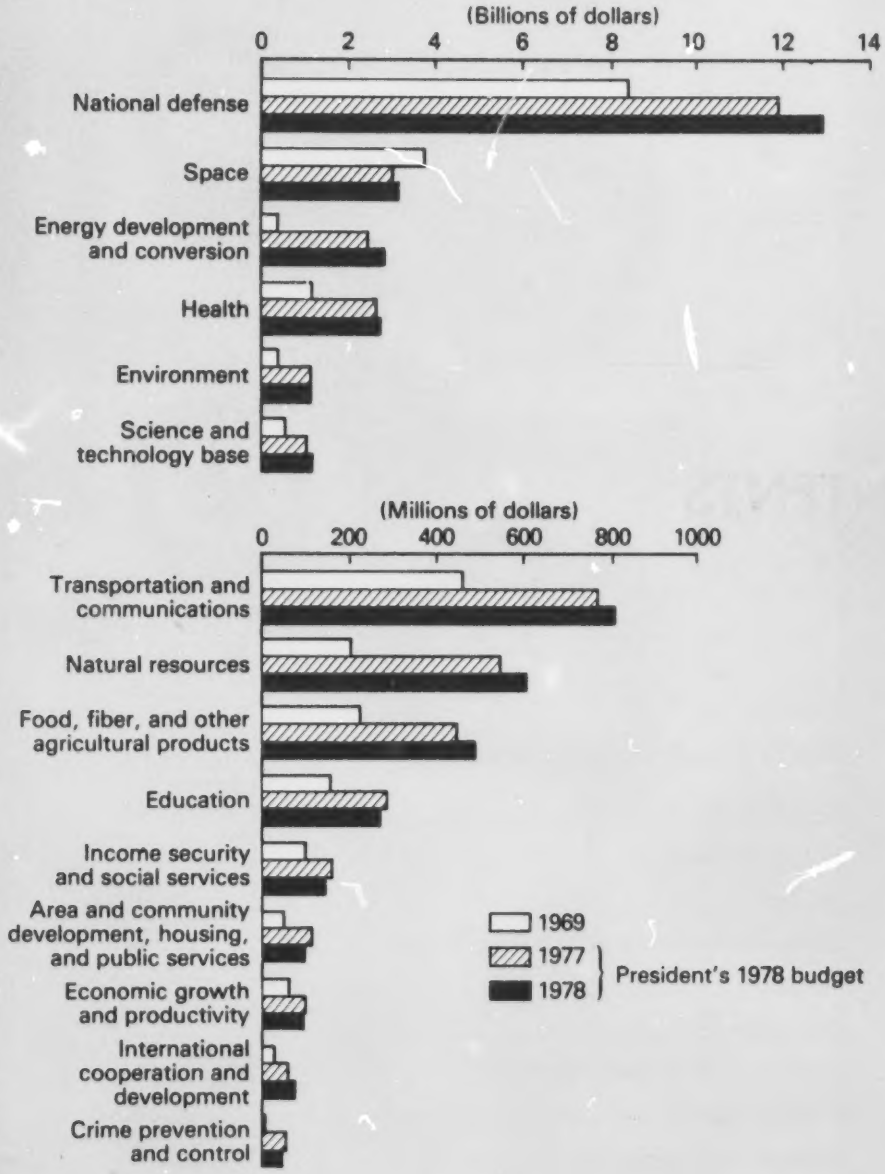
- National Defense 12
- Space 16
- Energy Development and Conversion 19
- Health 23
- Environment 27
- Science and Technology Base 32
- Transportation and Communications 35
- Natural Resources 40
- Food, Fiber, and Other Agricultural Products 46
- Education 49
- Income Security and Social Services 51
- Area and Community Development, Housing, and Public Services 53
- Economic Growth and Productivity 55
- International Cooperation and Development 57
- Crime Prevention and Control 59

Appendixes

- A. Technical Notes 62
- B. Detailed Statistical Table 65

* Sections are presented in descending order of Federal R&D obligations in the 1978 budget.

FEDERAL R&D OBLIGATIONS BY FUNCTION, FY 1969, 1977 (est.) and 1978 (est.)



SOURCE: National Science Foundation

HIGHLIGHTS

- Federal R&D obligations were an estimated $24.5 billion in fiscal year 1977, representing an average annual growth rate of 5.8 percent since 1969. Most of the growth during this 8-year period took place between 1974 and 1977, when the average annual gain was 12.0 percent, or 4.1 percent in constant dollars.[1] The President's budget proposal for fiscal year 1978 called for a further increase of 7.6 percent to $26.3 billion.

- The six leading R&D functional areas (defense, space, energy, health, environment, and science and technology base) have been the focus of most of the recent growth, accounting for 92 percent of the $8.9 billion that has been added to the Federal R&D total between 1974 and 1978.

- Between 1969 and 1977 a sharp rise occurred in the emphasis on civilian R&D programs as compared with those for defense and space. During this period the defense/space share of the Federal R&D total dropped from 77 percent to an estimated 61 percent, while civilian R&D programs grew from 23 percent to an estimated 39 percent, largely influenced by growth in energy and health R&D activities. Estimates based on the President's 1978 budget request show no change in these ratios.

[1] In the absence of a reliable R&D cost index the GNP implicit price deflator has been used for the years 1969-77.

- A comparison of the 1978 budget proposal with funding levels during the previous 3 years reveals a continuation of earlier growth patterns for defense, space, and most functional categories that reflect research and development in areas involving primarily the development and utilization of physical resources, such as energy, natural resources, and agriculture. These functions reflected proposed increases for 1978 over 1977 ranging from 10 percent in agriculture to 17 percent in energy development and conversion. National defense showed an increase of 8 percent and space an increase of 6 percent. Environment was the exception in that it showed a very slight change downward.

- Proposed funding for socially oriented programs, on the other hand, (with the exception of health, transportation and communications, and international cooperation and development) reflected a reversal of the growth pattern which occurred generally for this kind of program throughout the 1975-77 period. The 1978 budget called for decreases in education; income security and social services; area and community development, housing, and public services; economic growth and productivity; and crime prevention and control. Health, which because of its size and character is in a special class, was proposed at a level 2 percent over 1977 although later congressional action has had the effect of further increasing the 1978 level of support. Transportation and communications increased 5 percent in the 1978 budget. International cooperation and development showed a 33-percent increase.

- Science and technology base funding, as proposed in the 1978 budget, continued the uninterrupted upward trend that has prevailed since 1972, with an 11-percent increase in 1978 over the 1977 level.

INTRODUCTION

The purpose of this report is to provide a consistent system by which Federal R&D programs are grouped by selected functions according to the primary purpose of each program with no overlapping between functional areas. When extended over a time period — in this case fiscal years 1969 through 1978 — this system affords a view of changing Federal R&D priorities and also a measure of trends in the funding of individual programs and program areas.

The present report is the seventh in a series that has evolved to provide a basis for the analysis of Federal R&D activities by function or objective. The program data are provided in the annual National Science Foundation (NSF) survey that covers agency support of R&D programs by character of work, performers, and fields of science.[1] The original function analyses grouped agency R&D programs by the function categories used in the overall Federal budget. Under that system, however, the objectives of many R&D programs were obscured or distorted because the grouping of functions by overall agency missions did not provide adequate visibility for the objectives of R&D programs as such. Starting with the 1973 budget data, an attempt was made at an alternative system that reflected R&D objectives only, and thereafter this system was adopted annually for the function series.

[1] The *Federal Funds for Research, Development, and Other Scientific Activities* series dates from fiscal year 1952 and covers all agencies that support R&D programs. Detail on individual programs, however, is obtainable back to 1969 only.

Functional data are additive to 100 percent so that the total of all R&D programs for a given year in this report will match the total of all R&D programs for that year in the *Federal Funds* report. The primary purpose of each R&D program was determined by NSF staff rather than the agencies. In most cases the primary purpose was evident from descriptions provided by the sponsoring agency, but in some cases two almost equally important purposes might be discernible. With all Federal R&D programs available for simultaneous study and comparison a total perspective was provided from which fine points of difference could be resolved.

The data for 1976-78 were collected by NSF from the agencies in the *Federal Funds* survey in March and April 1977, and they are based on the agency budgets as incorporated in the President's budget message. The 1978 data show amounts requested in the President's budget for fiscal year 1978 and, therefore, do not reflect subsequent congressional appropriations or changes made by Executive apportionment. Fiscal year 1977 data reflect obligations estimated in the second quarter of fiscal year 1977; agencies base these estimates on funds appropriated plus obligations carried over from prior years and on agency program plans at the time. Program amounts shown in the detailed statistical table (appendix B) may differ somewhat from totals shown in these agency budgets because of the addition of administrative costs to program costs by NSF staff. Significant known changes in the 1978 data resulting from congressional actions taken at the time this report was prepared are noted in the text.

Each year organizational changes take place within the executive branch through the formation of new agencies, termination of others, and interagency program transfers. The latest agency structure was used in the appendix table and in the text tables, and prior-year data were spread to conform to this structure as though Federal agencies had been organized that way since 1969. When program emphases change as well, prior-year programs are sometimes split and recombined to conform to the new program directions.

Function categories were chosen on the basis of size of effort, current public interest in a given area, and the need for a complete framework covering all Federal R&D programs. The selected categories may fail to point up areas considered important by analysts with particular interests. The point should therefore be made that it is possible to regroup the programs shown in appendix table B under different function headings than are used in this report.

Aside from groupings under new function headings, larger groupings of programs under the present headings can also be made as long as the "100 percent additive" requirement is ignored. With secondary purposes permitted as a basis for inclusion, energy and energy-*related* programs, for example, can be shown under energy, and health and health-*related* programs can be shown under health. Such a system nullifies any analysis of relative priorities, although it may be very useful in assessing the extent of R&D activity bearing upon a given area.

FEDERAL AGENCY/PROGRAM ABBREVIATIONS

ADAMHA	—	Alcohol, Drug Abuse, and Mental Health Administration
ARS	—	Agricultural Research Service
BLM	—	Bureau of Land Management
BLS	—	Bureau of Labor Statistics
CDC	—	Center for Disease Control
CG	—	Coast Guard
CSA	—	Community Services Administration
CSRS	—	Cooperative State Research Service
DEA	—	Drug Enforcement Administration
DOD	—	Defense, Department of
DOT	—	Transportation, Department of
EPA	—	Environmental Protection Agency
ERDA	—	Energy Research and Development Administration
ERS	—	Economic Research Service
FAA	—	Federal Aviation Administration
FBI	—	Federal Bureau of Investigation
FDA	—	Food and Drug Administration
FHWA	—	Federal Highway Administration
FRA	—	Federal Railroad Administration
FS	—	Forest Service
FWS	—	Fish and Wildlife Service
GARP	—	Global Atmospheric Research Program
GS	—	Geological Survey
HEW	—	Health, Education, and Welfare, Department of
HRA	—	Health Resources Administration
HSA	—	Health Services Administration
HUD	—	Housing and Urban Development, Department of
IDOE	—	International Decade of Ocean Exploration
LEAA	—	Law Enforcement Assistance Administration
NASA	—	National Aeronautics and Space Administration
NBS	—	National Bureau of Standards
NHTSA	—	National Highway Traffic Safety Administration
NIE	—	National Institute of Education
NIH	—	National Institutes of Health
NOAA	—	National Oceanic and Atmospheric Administration
NRC	—	Nuclear Regulatory Commission
NSF	—	National Science Foundation
OE	—	Office of Education
OEP	—	Office of Emergency Preparedness
OHD	—	Office of Human Development
OMBE	—	Office of Minority Business Enterprise
OS	—	Office of the Secretary (DOT) (HEW) (Interior) (Labor)
OWRT	—	Office of Water Research and Technology
RANN	—	Research Applied to National Needs
SRS	—	Social and Rehabilitation Service
SSA	—	Social Security Administration
TVA	—	Tennessee Valley Authority
UMTA	—	Urban Mass Transportation Administration
USDA	—	Agriculture, Department of
VA	—	Veterans Administration

Part I

FEDERAL R&D PRIORITIES BY FUNCTION

SHARE OF FUNCTIONS IN FEDERAL R&D TOTAL WITH SUBFUNCTIONS: FY 1978 (est.)

Federal R&D Obligations $26.3 billion

National Defense	49.0%
Space	11.9%
Energy Development and Conversion	10.6%
Health	10.2%
Environment	4.2%
Science and Technology Base	4.0%
Transportation and Communications	3.1%
Natural Resources	2.3%
Food, Fiber, and Other Agricultural Products	1.9%
Education	1.0%
Income Security and Social Services	0.6%
Area and Community Development, Housing, and Public Services	0.4%
Economic Growth and Productivity	0.4%
International Cooperation and Development	0.3%
Crime Prevention and Control	0.2%

- Defense military
- Defense-related atomic energy
- Other defense-related

- Manned space flight
- Space sciences
- Space technology
- Supporting space activities

- Nuclear
- Fossil
- Solar and geothermal
- Conservation
- Other

- Biomedical research
- Mental health
- Delivery of health care
- Drug abuse prevention and rehabilitation

- Environmental health and safety
- Pollution control and environmental protection
- Understanding, describing, and predicting the environment

- Air
- Ground
- Water
- Multimodal
- Communications

- Mineral
- Water
- Land
- Recreation
- Multiresource

- Production
- Marketing and distribution
- Other

SOURCE: National Science Foundation

2

- Although Federal R&D obligations have risen from $15.6 billion in fiscal year 1969[1] to an estimated $26.3 billion in fiscal year 1978, most of the growth has occurred in the last 4 years. Between 1969 and 1974 the average annual rate of growth was 2.2 percent, or a decline in constant dollars[2], whereas from 1974 to 1978 the average annual growth rate is 10.9 percent, or an increase of 3.0 percent in constant-dollar terms.

- The six leading R&D functional areas are the focus of most of this recent growth. Together they account for 92 percent of the $8.9 billion that has been added to the Federal R&D total between 1974 and 1978.

- Two of these areas—national defense and energy development and conversion—account for 44 percent and 25 percent, respectively, of the overall gain. Space and health each account for 7 percent. The environment area covers 5 percent of all the R&D program growth, and science and technology base, 4 percent.

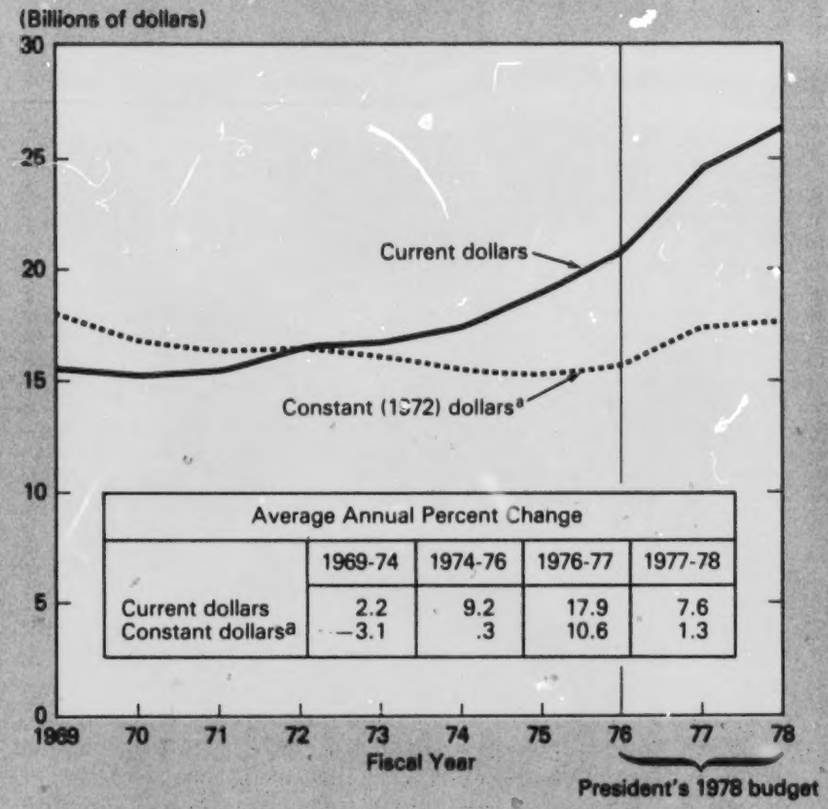
- In earlier years, 1969-74, areas contributing most to Federal R&D growth slight though it was, were health, defense, environment, energy, transportation and communications, and natural resources.

- Between 1974 and 1976 an acceleration took place in the funding of R&D programs. In 1975 and 1976 overall Federal growth each year was 9.2 percent, a higher relative growth by far than any previous year in the series. During the 2-year period, eight of the nine leading functional areas showed growth and six grew at rates sharply higher than they had shown in the 1969-74 timespan.

[1] Data on Federal R&D funding by function are available for prior years back to 1969 only. Accurate detail for earlier years is not obtainable.

[2] In the absence of a reliable R&D cost index the GNP implicit price deflator has been used for the years 1969-77, and an estimate has been made for inflation in 1978.

FEDERAL R&D OBLIGATIONS: FY 1969-78



Average Annual Percent Change				
	1969-74	1974-76	1976-77	1977-78
Current dollars	2.2	9.2	17.9	7.6
Constant dollars[a]	−3.1	.3	10.6	1.3

[a]Based on GNP implicit price deflator with an estimate for FY 1978.

SOURCE: National Science Foundation

- In 1977 all 15 functional areas reflected increases, and most areas showed high increases. Even though in a number of cases part of the rise resulted from funds carried over from prior-year obligations, the increases in budget authority were still significant. The increases did not, however, reflect an overall Federal policy but rather a confluence of administration and congressional actions in each individual area.

Federal R&D obligations by function:[1]
Average annual percent change in selected periods

Function	1969-74	1974-76	1976-77[2]	1977-78[2]
Total	2.2	9.2	17.9	7.6
National defense	1.4	5.6	15.2	8.3
Space	-7.8	7.5	3.8	5.6
Energy development and conversion	13.0	50.0	72.3	17.0
Health	13.2	6.2	10.8	2.3
Environment	17.1	13.9	22.4	(3)
Science and technology base	6.2	9.9	13.5	11.3
Transportation and communications	8.9	-4.9	20.9	4.7
Natural resources	11.1	19.8	11.9	11.5
Food, fiber, and other agricultural products	5.3	15.5	14.3	10.0
Education	2.3	-9.4	99.2	-5.1
Income security and social services	6.7	-.2	16.8	-5.0
Area and community development, housing, and public services	14.3	4.0	6.0	-10.3
Economic growth and productivity	5.2	8.0	16.9	-1.3
International cooperation and development	-.1	29.0	19.8	32.8
Crime prevention and control	50.0	-.1	34.8	-9.2

[1] Listed in descending order of 1978 obligations.
[2] Estimates based on the President's 1978 budget.
[3] A decrease of less than 0.05 percent.

SOURCE: National Science Foundation

- Of the 17.9-percent growth in 1977 for total Federal R&D obligations, more than one-fourth can be attributed to estimated carryovers and the rest to anticipated program expansion.

- The 1978 budget contained requests for R&D support that totaled 7.6 percent more than in 1977 and that made for increases for each of the nine major functional areas[3] except one—environment. Five of the six minor areas reflected decreases. The final amounts of increase and decrease for all areas will vary somewhat from levels cited here that were shown in the 1978 budget.[4]

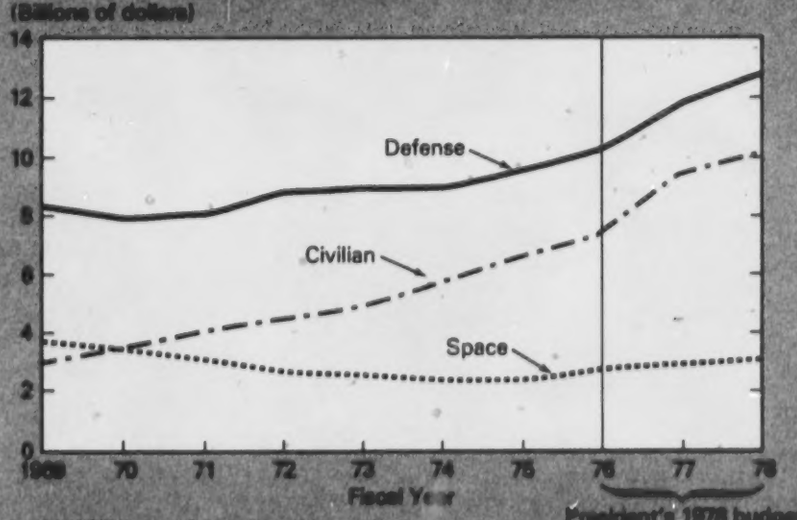
[3] Major functions are defined as those with current annual funding levels that round to $500 million or more.

[4] For 1978 program amounts include estimates for carryovers, and they have the added uncertainty of not reflecting congressional action. The record has shown, however, that most of the requested amounts are appropriated and that obligations estimated for the midyear that did not take place that year do take place in the budget year, which becomes the midyear 12 months later. For these reasons the continuing upward trend in overall Federal R&D funding indicated here for 1977 and 1978 can be considered an accurate picture.

- During the 1969-78 timespan national defense and space remained continuously in first and second position in R&D support, but in the 1978 budget request energy moved to the third-rank position, replacing health, which had been in third place in all previous years.

- Between 1969 and 1978 an outstanding feature of Federal R&D support has been the sharp rise in emphasis on civilian R&D programs as compared with those for defense and space. In 1969 the defense/space share was 77 percent, but in 1978 the ratio is an estimated 61 percent. Since 1974, however, defense R&D programs have shown a strong and steady rise and those of space, a moderate increase. In the meantime funding for energy has grown steeply and for other civilian areas more gradually, offsetting the defense/space gains. Over the longer 1969-78 period, approximately two-fifths of the total growth in civilian R&D programs has been shown by energy programs and more than one-fifth by health programs.

TRENDS IN FEDERAL OBLIGATIONS FOR DEFENSE, SPACE, AND CIVILIAN R&D PROGRAMS: FY 1969-78



SOURCE: National Science Foundation

- **National defense** has, throughout the 1969-78 period, accounted for approximately one-half of the Federal R&D total, but the share has shown a tendency to decrease. Whereas the ratio was 53.4 percent in 1969, it is an estimated 49 percent in 1978.

Little growth was shown in R&D funding for national defense from 1969 to 1974. Administration policy was focused on higher defense spending in the 1972 budget, following a 3-year period of no growth, and this policy was subsequently reflected in defense totals, especially after 1974. The effect on defense R&D actitivies, however, was somewhat delayed; after significant growth in 1972, R&D support did not rise substantially until 1975 but has continued in a positive upward trend since then. The requested total in the President's budget for 1978 was $12.9 billion, an 8-percent increase over 1977.[5]

Defense military programs include all those within the RDT&E appropriation of the Department of Defense (DOD) plus small amounts from other appropriations primarily covering pay and allowances of military personnel engaged in R&D activities.

[5] This increase may be smaller as a result of congressional action. As of November 1977 the Congress had cut the RDT&E requested total by approximately 2.5 percent. The effect on broad subfunctional areas of national defense could not be exactly determined, but presumably the increases between 1977 and 1978 will be smaller than indicated here for some areas.

Federal R&D obligations by function:[1] fiscal years 1969-78

[Dollars in millions]

Function	1969	1970	1971	1972	1973	1974	1975	1976	1977[2]	1978[2]
Total	$15,641.1	$15,340.3	$15,545.0	$16,497.8	$16,800.1	$17,414.7	$19.013.3	$20,758.6	$24,465.3	$26,316.7
National defense	8,353.7	7,976.3	8,106.1	8,897.7	8,997.9	8,974.6	9,620.9	10,346.2	11,917.0	12,906.8
Space	3,731.7	3,509.9	2,893.0	2,714.3	2,601.3	2,477.6	2,511.3	2,863.2	2,972.4	3,140.0
Energy development and conversion[3]	327.9	317.3	323.6	382.7	441.6	605.1	1,109.7	1,387.6	2,390.4	2,797.7
Health	1,126.8	1,125.8	1,338.0	1,588.8	1,624.3	2,096.4	2,176.9	2,365.5	2,622.2	2,682.6
Environment	315.2	354.1	464.6	533.3	651.5	693.0	837.1	899.4	1,100.7	1,098.3
Science and technology base	513.4	524.6	523.8	601.2	604.7	694.6	781.6	839.2	952.6	1,059.9
Transportation and communications	458.1	590.2	778.7	614.6	630.1	702.9	640.5	635.7	768.8	804.8
Natural resources	201.0	237.5	326.0	354.0	341.0	340.8	444.6	488.8	546.9	609.8
Food, fiber, and other agricultural products	225.0	240.6	246.9	290.7	296.9	291.0	348.5	388.3	444.0	488.3
Education	154.8	146.6	186.1	190.7	214.2	173.5	149.1	142.4	283.8	269.2
Income security and social services	96.7	105.6	127.8	125.2	157.2	133.8	148.5	133.4	155.9	148.0
Area and community development, housing, and public services	49.4	91.1	88.7	87.4	96.7	96.4	101.8	104.2	110.5	99.2
Economic growth and productivity	55.8	80.0	98.9	62.8	75.1	71.9	67.1	83.9	98.1	96.8
International cooperation and development	26.8	32.2	32.3	29.5	32.9	26.7	29.8	44.5	53.3	70.8
Crime prevention and control	4.8	8.6	10.3	25.0	34.8	36.3	45.9	36.3	48.9	44.4

[1] R&D plant excluded.

[2] Estimates based on the President's 1978 budget to Congress.

[3] The inclusion of R&D plant obligations for energy would add $266.7 million in 1976, $508.9 million in 1977, and $552.4 million in 1978.

SOURCE: National Science Foundation

Defense RDT&E programs have been reorganized under new headings to better point up key areas of interest[6], but data arranged by these categories are available back to 1972 only.

The largest area of R&D support is that of *tactical programs,* which in 1977 represented more than one-third of all RDT&E activities and have never represented less than three-tenths. The requested total in 1978 for these programs was 17 percent more than the 1977 total of $3.7 billion.

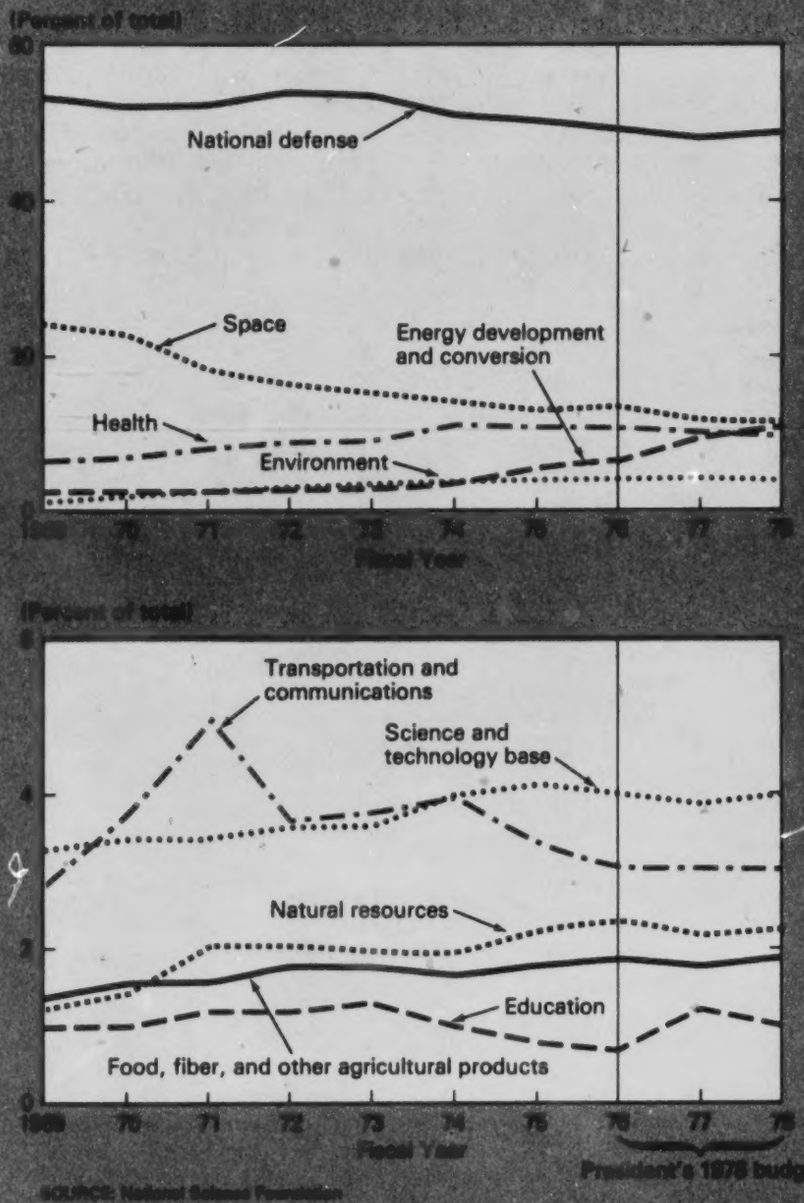
In air warfare systems, the budget request called for work to go forward on the Air Force F-16 and Navy F-18 fighter aircraft and accompanying air-to-air missiles. Development was to continue on V/STOL (vertical short takeoff and landing) technology. In land warfare, major development efforts included the Army XM-1 tank, the advanced attack helicopter (AAH), and the Patroit (SAM-D) air defense system. In ocean control, the major development effort was the LAMPS antisubmarine warfare helicopter. In combat support the most notable program was the Air Force advanced warning and control system (AWACS). These programs were all approved by the Congress although the V/STOL and AWACS programs were somewhat reduced from request levels and the AAH was increased.

Strategic programs, next in size within the RDT&E appropriation, totaled $2.3 billion in 1977, and no overall change was expected in the budget plan for 1978. Currently, these programs make up about one-fifth of the RDT&E total.

In 1978 a major development effort was to continue for the Navy Trident sea-launched ballistic missile system although at a lower level than in 1977 since this program is entering into procurement. Continued development was included in the budget for the Air Force B-1 bomber (procurement of which was later discontinued by the President while development was to go forward). Full-scale development was to begin on the Air Force M-X intercontinental ballistic missile. Two strategic cruise missiles—one Navy, one Air Force—were to continue in full-scale development. These plans were largely concurred in by the Congress.

[6] The former RDT&E headings were military sciences; aircraft and related equipment; missiles and related equipment; military astronautics and related equipment; ships, small craft and related equipment; ordnance combat vehicles, and related equipment; other equipment; and programwide management and support.

TRENDS IN DISTRIBUTION OF FEDERAL R&D OBLIGATIONS FOR SELECTED FUNCTIONS



SOURCE: National Science Foundation

Technology base programs were at the $1.7 billion level in 1977, and the budget request included a 10-percent rise for this area in line with DOD policy initiated in the 1976 budget to reverse a real long-term decline.

Intelligence and communications, which more than doubled between 1972 and 1977 to reach a level of $1.0 billion, was expected to grow 11 percent in the 1978 budget request.

Advanced technology development showed a small increase in the 1978 budget request.

Programwide management and support showed virtually no growth between 1972 and 1976 but a rise to $1.3 billion in 1977. No increase was requested in 1978. This activity covers Federal contract research centers, ranges, test facilities, and studies and analyses.

Defense-related atomic energy programs, which have been entirely conducted by the Energy Research and Development Administration (ERDA), showed increases in the 1978 budget plan: weapons R&D and testing to grow 6 percent and naval reactor development to grow 11 percent. These plans were approved by the Congress.

- **Space** is the only function with lower funding in 1977 and 1978 than in 1969. During this period the share of space within the Federal R&D total has fallen from 23.9 percent to an estimated 12.1 percent in 1977 and 11.9 percent in 1978.

  Manned space flight has always been the largest subfunction, accounting in 1977 for two-thirds of the space R&D total. As the Apollo program of the National Aeronautics and Space Administration (NASA) phased down to completion in 1973, the share of the manned space subfunction decreased but always made up more than one-half of all space support. In 1973 the Skylab was the leading program but by 1974 had yielded to the space shuttle and thereafter been terminated. Since then the rapidly growing space shuttle program has not only dominated manned space flight but has also been the leading space program overall. By 1975 the rise in obligations for the space shuttle produced a rise in obligations for the space function that has continued each year since then.

The space shuttle was proposed for only nominal dollar growth in 1978 (2 percent) since development had advanced to the point of an initial approach and landing test in 1977 and a first manned orbital flight the same year. Accompanying the development of this versatile system is a NASA program in space transportation system (STS) operations capability development. This program was expected to grow almost five times from 1977 to 1978, and Congress has confirmed the budget expectation. This program was approved.

Within the *space sciences* subfunction the broad NASA physics and astronomy program reflected a proposed 35-percent increase that included the start of development on a 2.4-meter space telescope to be launched by the shuttle in 1983. This program was approved.

The NASA lunar and planetary exploration program, however, reflected an 18-percent drop in the 1978 budget request. The decline in funding in this area since 1973 has reduced the share of space sciences within the space function. Despite an overall reduction, funds were included for a new mission—the Jupiter orbiter/probe, which was subsequently approved by Congress.

Space technology is scheduled to rise substantially in 1978,[7] largely because of the NASA space research and technology program to provide a technology base for space activities including shuttle payloads efforts.

Supporting space activities cover NASA tracking and data acquisition, scheduled for a 10-percent increase in 1978.

- **Energy development and conversion** has shown unprecedently large gains for a major function ever since 1974. The average annual growth rate for energy R&D programs between 1969 and 1974 was 13.0 percent; between 1974 and 1978, an estimated 47.0 percent. As a share of all Federal R&D programs, those in energy have grown from 2.1 percent in 1969 to an estimated 9.8 percent in 1977 and 10.6 percent in 1978.

  In 1978 nuclear programs in the President's budget made up more than one-half of the energy R&D total compared with more than nine-tenths in 1969. Although steady growth has been shown

[7] The term "scheduled" refers to congressional action.

since 1971 in support to the nuclear area, R&D support to nonnuclear areas has grown more rapidly, especially from 1975 onward.

As a group, the *nuclear* programs were expected to rise 15 percent in 1978 in the budget proposal. Obligations for the ERDA liquid metal fast breeder reactor (LMFBR), the largest program, showed a decrease from 1977 in the President's budget and later Presidential and congressional action further reduced the program in the form of a cutback in support for the Clinch River breeder reactor as well as for the base program. ERDA fuel cycle research and development, the second largest program, doubled over 1977 in the 1978 budget request. The ERDA magnetic fusion program was expected to grow 8 percent; ERDA nuclear research and applications, 14 percent; reactor safety research of the Nuclear Regulatory Commission (NRC), 22 percent; and ERDA laser fusion research, 26 percent. Subsequent Presidential and congressional action has further increased these programs.

Nonnuclear programs as a whole reflected a 19-percent increase in the budget request. Among these, coal utilization research by ERDA, the largest program under the fossil subfunction, was expected to show a decline in 1978 because of the large 1977 carryover, but congressional appropriations for some subprograms may result in a 1978 increase.

Solar and geothermal energy development continued strong recent growth with substantial increases granted by Congress to both solar and geothermal R&D efforts.

Energy conservation was the chief growth area in the 1978 budget, and it is now scheduled to more than double, with sharp expansion planned in end-use conservation and technologies.

- **Health** R&D programs revealed only a slight (2 percent) increase in the 1978 budget. Obligations in 1977 were high because of the effects of a congressional override of the President's veto of the 1976 appropriation for the Department of Health, Education, and Welfare (HEW) midway in the fiscal year. The resulting increase carried into 1977. Later congressional action has had the effect of increasing the 1978 total substantially. Over the longer term funding for health has grown substantially; the average annual rate is almost twice that of overall Federal R&D funding. The share of health in the Federal total has risen from 7.2 percent in 1969 to an estimated 10.7 percent in 1977 and 10.2 percent in 1978.

Biomedical research accounts for 9 out of 10 health R&D dollars, a share that has increased somewhat since 1969. A Presidential policy decision in 1972 added impetus to growing support for cancer research, which continued to rise every year thereafter. Additional emphasis was placed on heart and lung research in 1974 with increases in subsequent years. Between 1969 and 1976 the share of cancer research within the biomedical research total grew from 17 percent to 31 percent. In the current period (1976-78) other areas are showing faster rates of growth than cancer and heart and lung research, among them arthritis, metabolism, and digestive diseases; aging; eye diseases; and environmental health sciences.

Mental health research is now scheduled to increase somewhat in 1978 over 1977, but the increase over 1969 is still not large.

Delivery of health care revealed a slight reduction in the 1978 budget proposal.

Drug abuse prevention and rehabilitation is scheduled to support the same level of effort in 1978, an amount that has scarcely changed since 1975.

- The **environment** function was expected to show almost the exact total in 1978 as shown for 1977. Over the longer term, however, this area has been among the more rapidly growing, with an average annual rate almost three times that of Federal R&D activities as a whole between 1969 and 1978. The share of environment within the Federal total has grown from 2.0 percent in 1969 to an estimated 4.5 percent in 1977 and 4.2 percent in 1978.

Environmental health and safety remains the leading subfunction, accounting for almost two-fifths of the total environment effort in 1977. The largest program is sponsored by ERDA in environmental research and development related to new energy technologies. A substantial increase was scheduled for 1978. The rapid growth of this program has had a marked influence on the growth of the whole subfunction.

Pollution control and environmental protection, more than one-third of the environmental total in 1977, reflected a decrease overall in the President's budget for 1978. This decrease was almost entirely caused by apparent declines in several programs of the Environmental Protection Agency (EPA) that had reflected a carryover of unobligated funds into 1977. No actual decline in effort is anticipated.

Understanding, describing, and predicting the environment was expected to show slight growth in 1978, making total programs in this area more than one-fourth of the environment total. Two NASA programs in ocean and weather monitoring and forecasting are now scheduled for decreases, but these are more than offset by a Geological Survey (Interior) increase for mapping of earthquake geological hazards and for a National Science Foundation (NSF) program in earthquake engineering.

- **Science and technology base** has been a growth area since 1974 when increases in NSF research project support and in ERDA high-energy physics, basic energy sciences, and nuclear physics were sufficient to produce a decided upward change in the function total. These programs are the chief ones within the science and technology base function. Between 1969 and 1977 the share of this function in the Federal R&D total rose from 3.3 percent to an estimated 3.9 percent, and the anticipated share in 1978 was 4.0 percent.

- **Transportation and communications** showed only a slight gain (5 percent) in the 1978 budget proposal. This function grew during the 1969-78 period, however, at a rate double that of all Federal R&D programs. The share within the Federal total was 2.9 percent in 1969 compared with an estimated 3.1 percent in 1977 and again in 1978.

  The *air* subfunction, which accounted for almost three-fifths of all function activity in 1977, largely represents the NASA aeronautical research and technology program, which is scheduled for moderate growth in 1978.

The *ground* subfunction showed a moderate decline in the budget, largely resulting from reduced railroad research and highway traffic safety research on the part of the Department of Transportation (DOT).

Other subfunctions, considerably smaller in size of funding, are *water* and *multimodal,* and each of these reflected a slight decrease in the 1978 budget request. The *communications* subfunction showed a significant increase, almost entirely from planning for the NASA space communications program.

- **Natural resources** reflected 12-percent growth in the 1978 budget. Growth for the 1969-78 period was more than twice that of Federal R&D funding overall. The 1969 share shown by this function was 1.3 percent but it was 2.2 percent in 1977 and anticipated to be 2.3 percent in 1978.

  The subfunctions of natural resources embrace *mineral, water, land, recreation,* and *multiresource* programs. The size and growth of one program—NASA earth resources detection and monitoring—now places the multiresource area first in size of funding, at more than one-third of the natural resources total in 1978. The second subfunction is concerned with mineral programs and makes up less than one-third of the function total, although a decrease as shown in the 1978 budget may be converted to an increase by congressional action on mining research programs.

- **Food, fiber, and other agricultural products** R&D support began to show important growth in 1975, which has continued significantly since then. The planned increase, as shown in the budget for 1978, was 10 percent. This function has increased from 1.4 percent of the Federal R&D total in 1969 to an estimated 1.8 percent in 1977 and 1.9 percent in 1978.

  Chief gains are found in programs within the *production* subfunction, important among them being a proposed competitive grant program for basic and applied research in areas related to long-range food needs.

Marketing and distribution programs also were expected to increase in 1978, mostly for work in marketing efficiency.

- The **education** function has revealed a fluctuating support history in the 1969-78 period. Heaviest funding areas have been HEW's National Institute of Education (NIE) and occupational, vocational, and adult education programs of the Office of Education (OE). Currently the latter program area is the largest within this function, and the drop in this program in the 1978 budget resulted in a decline in the level of education overall. The education share of the Federal R&D total was 1.0 percent in 1969, attained an estimated 1.2 percent in 1977, but was expected to be 1.0 percent in 1978.

- **Income security and social services** has varied in R&D support from one year to the next. The proposed 1978 level was the same as for 1975, a 5-percent decrease from 1977. Programs within this function are concerned with rehabilitation, employment and training, child development, special analytic studies of social questions, and public assistance research, to name the major ones. This function has never represented as much as 1 percent of all Federal R&D obligations.

- **Area and community development, housing, and public services** is a function that consists mainly of R&D programs of the Department of Housing and Urban Development (HUD) in housing assistance, housing economic data and analyses, community development, and related areas. Other programs in community and economic development and intergovernmental relations are also included. Growth for this function has been slightly ahead of growth for all Federal R&D programs in the 1969-78 period, but the share within the Federal R&D total has never been as much as 1 percent.

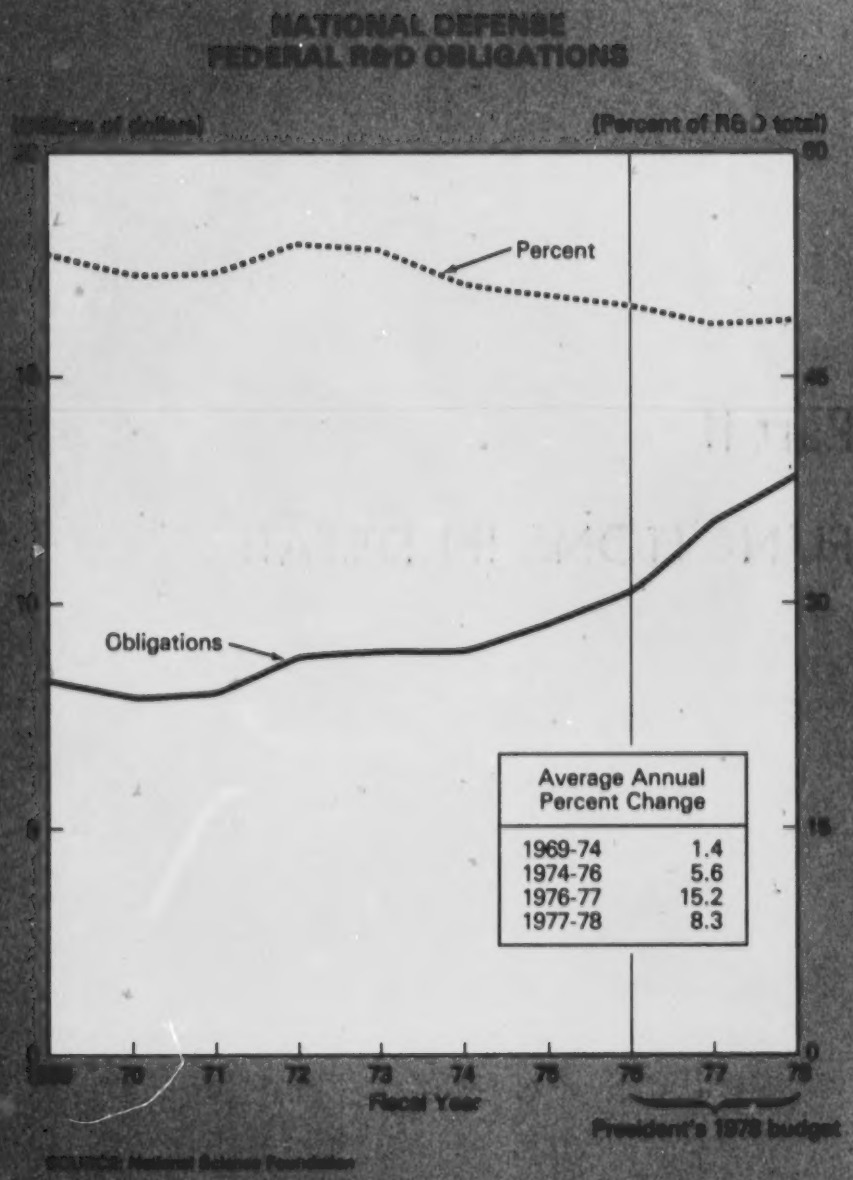
- **Economic growth and productivity** has shown sporadic growth. At present this function is made up of 24 programs of a number of agencies with differing missions. The programs include work on improving the use of materials, the use of forest products, and the use of space-generated and other technology, including computers. Studies of productivity and market behavior are also included.

- **International cooperation and development** shows growth almost twice that of all Federal R&D programs in the 1969-78 period. The chief program area within this function is made up of R&D efforts of the Agency for International Development (State), and the recent expansion of these programs is the chief cause of growth for the function.

- **Crime prevention and control** recorded the highest growth rate for any function in the 1969-78 timespan—28.0 percent. Starting from a small base, R&D programs, mostly represented by the Law Enforcement Assistance Administration (Justice), increased rapidly until 1975 but have shown little change in support since then.

Part II

FUNCTIONS IN DETAIL



NATIONAL DEFENSE

- Between 1969 and 1974 R&D obligations for national defense fluctuated fairly narrowly from one year to the next with the exception of a 10-percent rise in 1972. The average annual growth rate was 1.4 percent for this period. Since 1974, however, obligations have risen steadily, averaging 9.9 percent on an annual basis from 1974 to 1977. This larger growth in recent years has significantly influenced the overall Federal R&D level.

- In the President's budget an 8-percent increase in R&D support was reflected in 1978 over 1977, with most program areas showing increases. In the budget request the R&D total for the national defense function was an estimated $12.9 billion.

- The shares of national defense within the overall Federal R&D total were an estimated 48.7 percent in 1977 and an estimated 49.0 percent in 1978. These compare with a peak ratio of 53.9 percent in 1972.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
National defense, total	$8,353.7	$10,346.2	$11,917.0	$12,906.8
	Percent distribution			
Defense, military	92.0%	93.1%	93.5%	93.6%
Tactical programs (DOD-RDT&E)	88.4	28.0	31.2	33.8
Strategic programs (DOD-RDT&E)		21.5	18.9	17.4
Technology base (DOD-RDT&E)		14.4	14.3	14.6
Programwide management and support (DOD-RDT&E)		11.3	11.2	10.2
Intelligence and communications (DOD-RDT&E)		8.6	8.8	9.0
Advanced technology development (DOD-RDT&E)		5.4	5.4	5.3
Other DOD-military	3.6	4.0	3.7	3.3
Defense-related atomic energy	8.0	6.9	6.5	6.4
Weapons R&D and testing activities (ERDA)	6.6	5.1	4.9	4.8
Naval reactor development (ERDA)	1.4	1.8	1.6	1.6
Other defense-related activities	([2])	–	–	–
Office of Emergency Preparedness	([2])	–	–	–

[1] Estimates based on the President's 1978 budget to Congress.

[2] Less than 0.05 percent.

SOURCE: National Science Foundation

- The **defense military** subfunction accounts for almost 94 percent of the R&D funding total for national defense, and it includes all program areas except those for military applications of atomic energy.[8] Nearly the entire subfunction is made up of Department of Defense (DOD) RDT&E programs. Congress cut the 1978 budget request for these programs by approximately 2.5 percent. At the time this report was prepared, the effects of this action on broad program areas within the subfunction (tactical programs, strategic programs, etc.) could not be determined. It can be assumed that increases shown between 1977 and 1978 will be smaller in some areas than indicated. The following statements on funding for specific programs, however, are consistent with congressional action.

Tactical programs made up almost one-third of the national defense total in 1977, or $3.7 billion. A 17-percent rise in tactical programs in 1978 was requested in the President's budget. This was the largest dollar increase for any defense area and followed a similar situation in 1977.

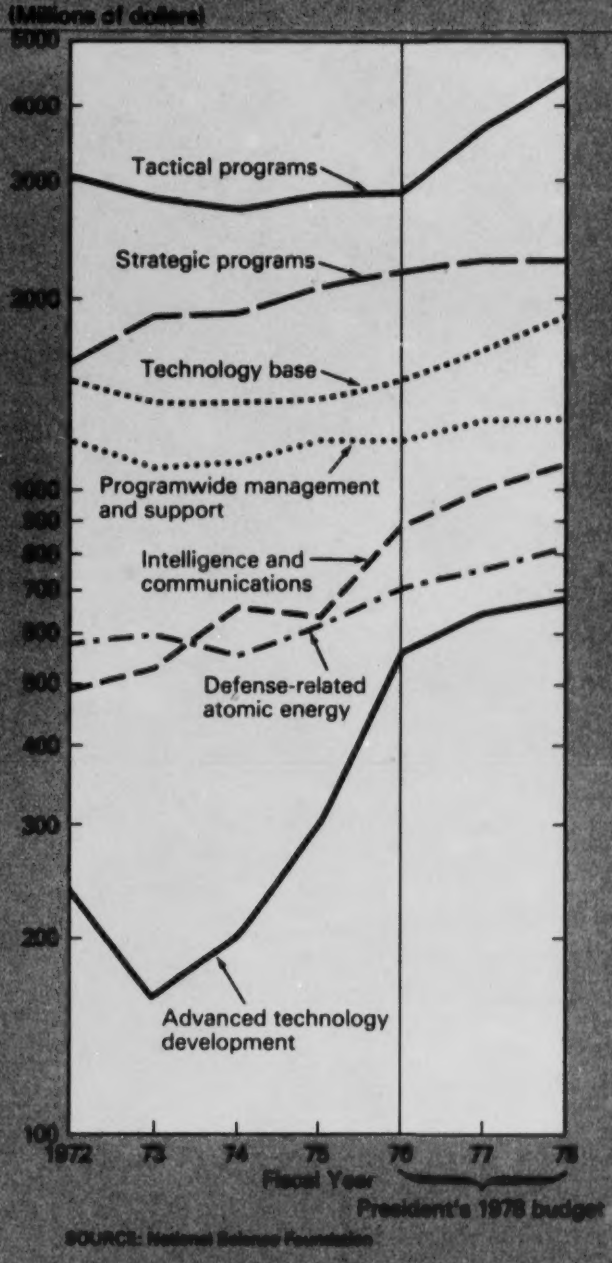
[8] This subfunction covers all obligations for the research, development, test and evaluation (RDT&E) appropriation, except for relatively small amounts used for R&D plant, plus minor amounts of R&D support from other appropriations, primarily pay and allowances of military personnel working in research and development. The RDT&E funds are broken into program areas, which in this report are treated as subcategories within the defense military subfunction. Obligations for some program areas show an erratic pattern with sharp increases and decreases. The reason is that development of a new weapons system from initial definition to completion of testing and introduction into the operating forces may take 5 or more years. As the definition phase is completed and the new system moves into full-scale development, steep increases in funding are required, but as this phase nears completion, funding falls off sharply.

The largest single program, the Navy F-18 air combat fighter, is scheduled for steep growth in 1978, producing the greatest upward pressure of any program on the rise in DOD tactical programs area. Smaller increases are shown for the Navy V/STOL aircraft, the Army SAM-D Patriot surface-to-air missile system, the Navy LAMPS helicopter, and Army Hellfire heliborne missile. The SAM-D program is the second largest single tactical program of DOD. Other large tactical programs include the Air Force F-16 air combat fighter (currently requiring lower funding as development enters later stages), the Army XM-1 tank, and the Air Force E-3A advanced warning and control system, the Army AAH helicopter and the Army U.S. Roland missile system.

Strategic programs made up almost one-fifth of the national defense total in 1977, or $2.3 billion. The budget request in 1978 kept the same overall level, although individual programs changed. This area has grown at the same rate as tactical programs from 1972 (the first year for which comparable data are available) to 1978.

The largest program is the Air Force B-1 bomber, already in later stages of development and thus reflecting a decrease from 1977. Presidential action was taken subsequent to the budget request to cancel procurement of this plane although development was to continue. The next largest program, the Navy Trident I submarine-launched missile system, reflects the largest decline of any strategic program since it is advancing into the procurement stage. The Navy Tomahawk strategic cruise missile, next in size, shows a considerable increase as development continues. An important increase is scheduled for the Air Force M-X intercontinental ballistic missile, now in full-scale development, as well as for the Air Force AGM-86, ALCM air-launched cruise missile. Two Army programs, important in size and showing a steady level of effort, are the ballistic missile defense systems technology program and the ballistic missile defense advanced technology program.

NATIONAL DEFENSE
FEDERAL R&D OBLIGATIONS BY SUBFUNCTION



SOURCE: National Science Foundation

Technology base programs accounted for 15 percent of the national defense function in 1977. A fairly sizable increase was proposed for 1978. Programs in this area are used to develop options for improving military capabilities. R&D activities seek to determine feasibility of principles and concepts related to promising technological advances.

The research effort is concentrated in engineering but includes all the science disciplines; performance is by a combination of in-house DOD laboratories, industry, and universities.

Programwide management and support covers Federal contract research centers, ranges, and test facilities and the funding of evaluative studies and analyses of weapons systems.

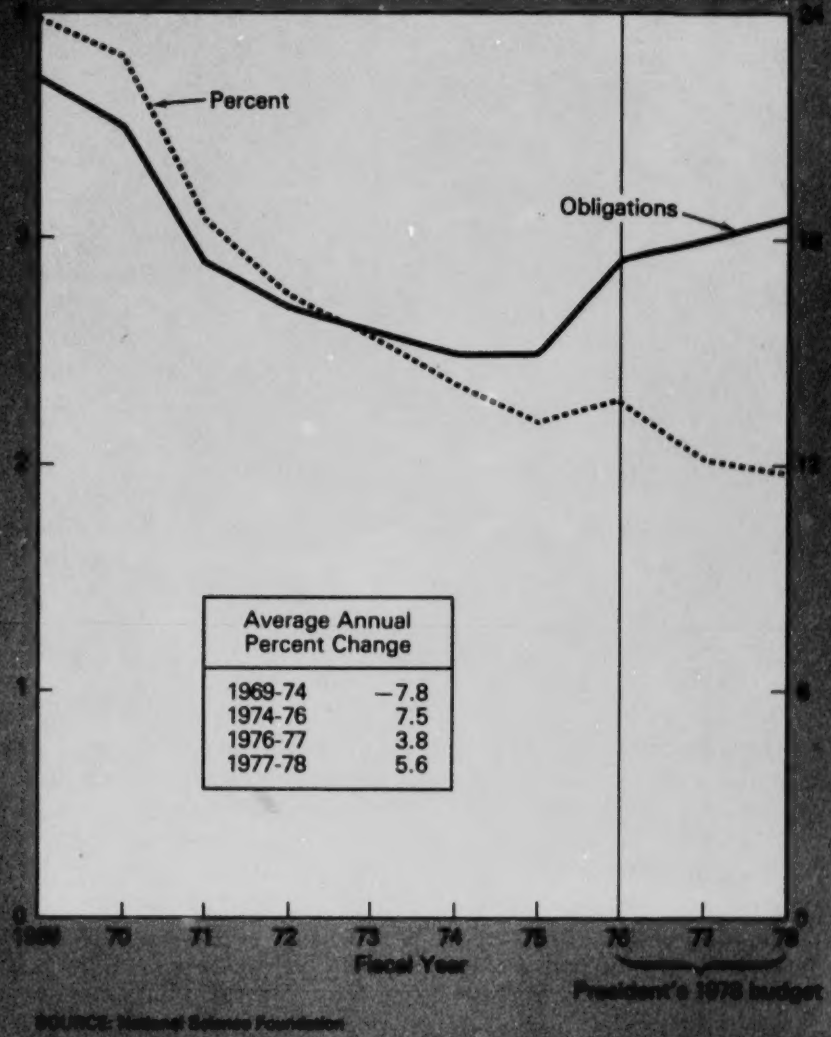
Intelligence and communications covers the development of new technical means of acquiring data on foreign threats to national security and new methods for disseminating these data. This R&D area has grown more rapidly than most other R&D areas of DOD, more than doubling between 1972 and 1977. An 11-percent increase was requested for 1978.

Advanced technology development programs are an extension of technology base R&D activities. Between 1972 and 1977 these programs almost tripled. Within this program area the concepts created within technology base are further developed for production and deployment testing in the field. A small increase was proposed in 1978 in the President's budget.

Other DOD military activities consist of R&D support by DOD that is outside the RDT&E appropriation. These mostly cover pay and allowances of military personnel working in research and development.

- **Defense-related atomic energy** consists of two broad programs of the Energy Research and Development Administration (ERDA). In this area growth has been uneven, but a continuous rise has been recorded since 1975. A 7-percent increase was proposed in 1978. Weapons R&D and testing activities are carried out in conjunction with the armed services. The naval reactor program, undertaken for the Navy, provides for the design and development of naval nuclear propulsion systems. Requested increases for these programs received congressional approval. Work in defense-related atomic energy is currently about 6 percent of the total defense R&D effort.

SPACE



- After a steady decline from 1969 to 1974, the trend for space R&D programs has been reversed, and continued expansion is shown in the current (1976-78) budget period. In 1978 an increase of 3 percent was requested, making the space total $3.1 billion.

- Despite recent gains, space is the only function with lower obligations in 1978 than in 1969. New R&D activities, such as those related to the space shuttle, have not offset the decline caused by the phaseout of the Apollo program in 1973.

- In 1969 the space share of total Federal R&D support was 23.9 percent, while in 1977 the share was estimated at 12.1 percent and in 1978 at 11.9 percent.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Space, total	$3,731.7	$2,863.2	$2,972.4	$3,140.0
	Percent distribution			
Manned space flight	70.4%	66.3%	68.1%	67.0%
Space shuttle (NASA)	–	42.0	44.2	42.8
Space flight operations (NASA)	4.2	6.6	6.7	8.5
Space transportation system operations capability development	–	.5	.6	2.6
Skylab	3.8	–	–	–
Other	.5	6.0	6.1	5.9
Expendable launch vehicle development and support (NASA)	1.6	5.8	5.1	4.3
Apollo (NASA)	55.8	–	–	–
Research and program management (NASA)	8.8	11.9	12.1	11.3
Space sciences	10.0	18.7	16.4	16.5
Physics and astronomy (NASA)	4.0	5.6	5.6	7.1
Lunar and planetary exploration (NASA)	2.8	8.9	6.4	5.0
Life sciences (NASA)	1.1	.7	.7	1.1
Research and program management (NASA)	2.1	3.6	3.7	3.3
Space technology	10.9	5.1	5.4	6.0
Space research and technology (NASA)	8.4	4.4	4.7	5.0
Space nuclear systems (ERDA)	2.5	.7	.7	1.0
Supporting space activities	8.7	9.9	10.1	10.5
Tracking and data acquisition (NASA)	8.7	9.9	10.1	10.5

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

Comments

- **Manned space flight** is the major component of space R&D funding, accounting for two-thirds of the space total. In 1978 funding was to increase slightly in the budget proposal. The NSA space shuttle, for which development efforts will continue toward initial operational capability in 1980, remains the largest program in manned space flight and in the space function, with an obligational level of more than $1.3 billion in both 1977 and 1978.

  The space shuttle is the first reusable space vehicle designed to carry different types of payload to and from low Earth orbit. Possible space shuttle missions will include retrieving payloads from orbit for reuse, servicing and repairing satellites in space, transporting and operating space stations, and performing rescue missions. In 1978 approach and landing tests will be completed, main propulsion tests initiated, and orbiter and main engine production started.

  Space flight operations, a supporting program area, reflected a 34-percent increase in the 1978 budget and this was approved by the Congress. This area includes development by NASA of a space transportation system (STS) operations capability plus development, test, and mission operations (DT&MO) activities related to all NASA missions. STS operations capability development covers the spacelab as well as upper stages, multiuse mission and payload support equipment, mission control center upgrading, and payload and operations support. Funding is scheduled to increase almost five times in 1978.[9] DT&MO activities, large in support, show a small planned increase.

  Expendable launch vehicle development and support efforts of NASA are expected to decrease 10 percent in 1978. These activities cover launch operations and engineering and maintenance to sustain launch activities, as well as reliability improvement of vehicles and ground-support equipment.

[9] The term "scheduled" in this report refers to congressional action.

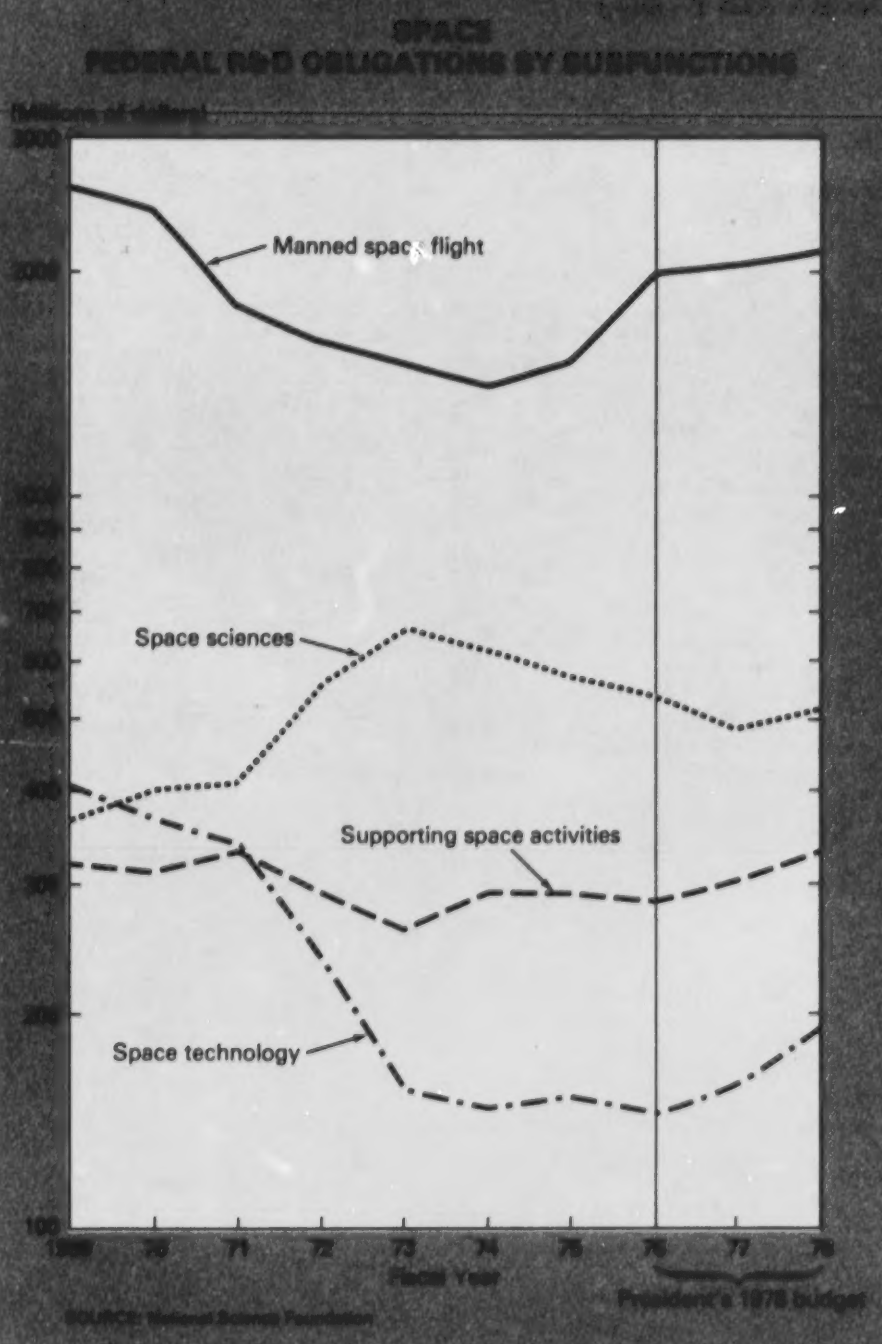
- **Space sciences** is the second largest subfunction, comprising one-sixth of the space total in 1978. The proposed 6-percent increase resulted from expansion in the NASA physics and astronomy program, which more than offset a decrease planned for NASA lunar and planetary exploration.

  The proposed 1978 increase of 35 percent in physics and astronomy provided for funds to begin development of the advanced Earth orbiting space telescope to be launched by the space shuttle in 1983 and also for funds to increase shuttle/spacelab payload development. Work will continue on the high-energy astronomy observatories designed to study X-ray, gamma ray, and cosmic ray sources. Work will proceed on the solar maximum mission satellite scheduled to be launched during the next period of peak solar flare activity in 1978-80.

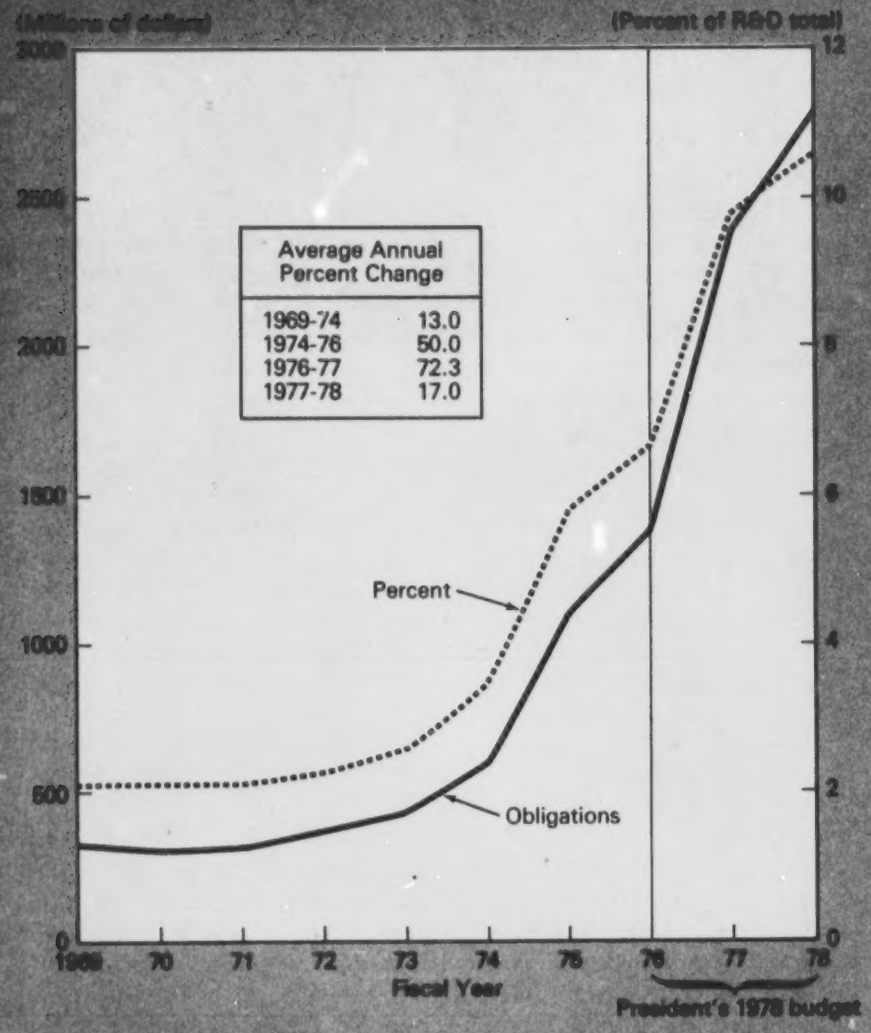
  The proposed 18-percent reduction in 1978 for lunar and planetary exploration was concurrent with the Pioneer missions to Venus and the Mariner missions to Jupiter and Saturn moving beyond the launch stage. Funds were included in the 1978 budget for a new mission, the Jupiter orbiter/probe, to be launched in 1981, and most of these funds were voted by Congress.

- **Space technology** is expected to rise 17 percent in 1978, but will account for less than one-tenth of total space R&D support. The predominant element of this subfunction is the NASA space research and technology program designed to establish a strong technology base for space activities. The increase of 12 percent for 1978 will provide for further emphasis on information systems, chemical and electric propulsion, and space energy systems. Support for the ERDA space nuclear systems program, the other element, is also expected to increase in 1978.

- **Supporting space activities** consists of only one program, the tracking and data acquisition support effort for the entire NASA flight program, including automated missions, sounding rockets, and aerodynamic test flights. The 1978 request for this program included a 10-percent increase in obligations, almost entirely approved by the Congress.



ENERGY DEVELOPMENT AND CONVERSION
FEDERAL R&D OBLIGATIONS



SOURCE: National Science Foundation

- Energy development and conversion continues as the leading growth area in Federal R&D funding. The level of support for this function surpassed $1 billion in 1975, $2 billion in 1977, and was set at $2.8 billion in 1978 in the President's budget request[10]. The 17-percent increase in 1978 was the largest relative gain of any major function.

- Over the 1969-77 period the average annual growth rate of 28.0 percent for energy development and conversion is the highest of any function except crime prevention and control.

- The energy development and conversion share of total Federal R&D support was 2.1 percent in 1969, and in 1977 it reached an estimated 9.8 percent and was expected to be 10.6 percent in 1978.

[10] The Office of Management and Budget (OMB) has cited higher Federal totals for energy R&D activities in 3977 and 1978 than are shown in this report: $2.9 billion and $3.9 billion, respectively. Differences arise not only from the fact that R&D plant data are included in the OMB figures but also from the fact that they are based on budget authority rather than obligations and include as well some program elements that would be regarded in this report as belonging under functions other than energy. In this report each program is assigned to a functional area on the basis of its primary purpose; e.g., an energy-related program whose primary purpose is environmental protection would be assigned to the environment function and would not appear under the energy function. In this report the energy totals for 1977 and 1978 would be $2.9 billion and $3.4 billion, respectively, if R&D plant were included. See Office of Management and Budget, *Special Analysis P: Federal Research and Development Programs, The Budget 1978*, p. 290 (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office).

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Energy development and conversion, total	$327.9	$1,387.6	$2,390.4	$2,797.7
	Percent distribution			
Nuclear	93.3%	59.5%	55.1%	54.2%
Liquid metal fast breeder reactor (ERDA)	63.8	25.1	22.7	17.3
Nuclear research and applications (ERDA)		7.5	5.8	5.6
Fuel cycle research and development (ERDA)	8.0	8.6	7.1	12.2
Uranium enrichment process development (ERDA)		3.5	2.9	3.1
Magnetic fusion (ERDA)	8.1	9.4	7.7	7.0
Reactor safety research (NRC)	7.5	5.6	3.8	4.0
Laser fusion (ERDA)	([2])	4.4	3.3	3.6
Reactor safety (ERDA)	–	–	1.2	.9
Other	6.0	.4	.8	.6
Fossil	6.1	23.3	23.0	19.6
Coal utilization (ERDA)	4.6	20.5	19.4	15.6
Petroleum and natural gas (ERDA)	.8	1.7	1.9	2.5
In situ technology (ERDA)	.7	1.0	1.5	1.4
Other	–	.1	.1	.1
Solar and geothermal	–	9.1	13.1	13.2
Solar energy development (ERDA)	–	6.9	10.9	10.2
Geothermal energy development (ERDA)	–	2.2	2.2	3.1
Conservation	.6	6.2	7.5	12.0
End use conservation and technologies to improve efficiency (ERDA)	–	2.4	3.8	7.8
Electric energy systems and energy storage (ERDA)	–	2.3	2.3	3.0
Improvement in power systems technology (TVA)	([3])	.6	.6	.6
Energy extension service (ERDA)	–	–	.3	.3
Other	.6	.9	.4	.3
Other	–	1.9	1.3	.9
Energy programs (NASA)	–	1.7	1.1	.9
Federal Energy Administration	–	.2	.3	–

[1] Estimates based on the President's 1978 budget to Congress.

[2] Laser fusion was included in weapons R&D and testing activities prior to 1974.

[3] Less than 0.05 percent.

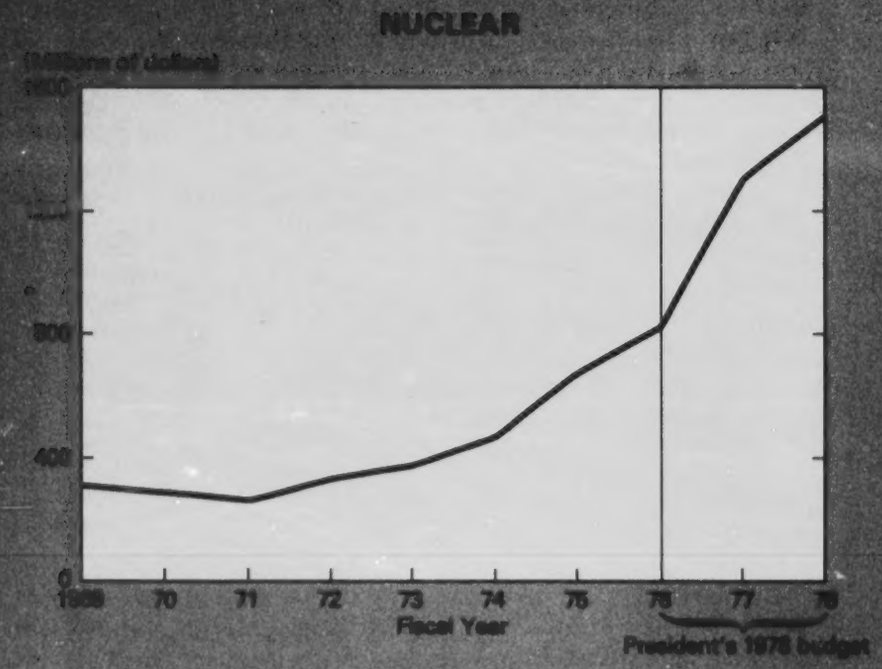
SOURCE: National Science Foundation

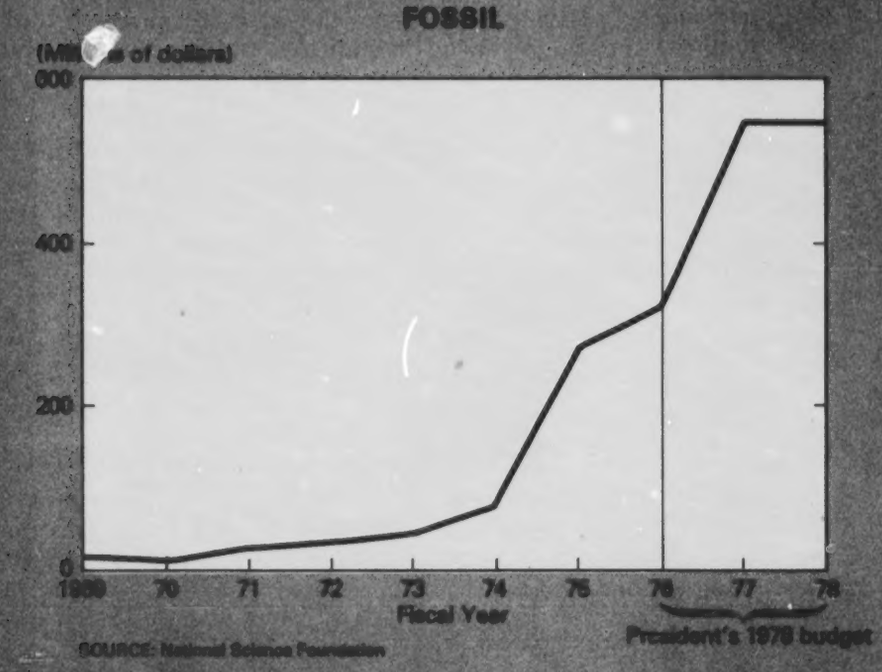
Comments

- The **nuclear** subfunction is still predominant, accounting for 54 percent of the energy function total in 1978. Although funding of nuclear energy R&D programs has grown rapidly, the share of nuclear energy within the energy total has declined from 93 percent in 1969 to the present ratio as energy R&D support has broadened. Even so, the 15-percent increase in the President's budget in 1978 placed nuclear R&D obligations at almost five times the 1969 support level.

  The ERDA liquid metal fast breeder reactor (LMFBR) is the largest single program within the energy function, accounting for 17 percent of the total energy effort in 1978, as shown in the budget. The objective of this program has been to develop and demonstrate an LMFBR power system, including supporting fuel cycle and safety and environmental concerns, to the point where private industry and utility continuation is economically and environmentally sound. The President's budget request included an 11-percent decrease in this program in 1978, but later Presidential and congressional action reduced the program further in the form of a cutback in support to the Clinch River breeder reactor project and to the base program.

  Nuclear research and applications, covering a group of ERDA programs related to breeder and conventional reactors, is scheduled for growth in 1978. ERDA fuel cycle research and development, one of the larger energy programs, is also scheduled for growth. This program covers waste management, reprocessing technology, and uranium resource assessment. Uranium enrichment process development is scheduled for some reduction. This program is concerned with enrichment of uranium as fuel in nuclear power reactors.





SOURCE: National Science Foundation

Magnetic fusion and laser fusion, both reflecting growth in the budget proposal, are now scheduled for slightly greater growth in 1978. Various approaches will be continued toward the magnetic confinement of fusion plasmas, with emphasis on the Tokamak and magnetic mirror concepts. In the laser fusion program the chief effort is to determine the feasibility of laser - and electron-beam-initiated thermonuclear burn.

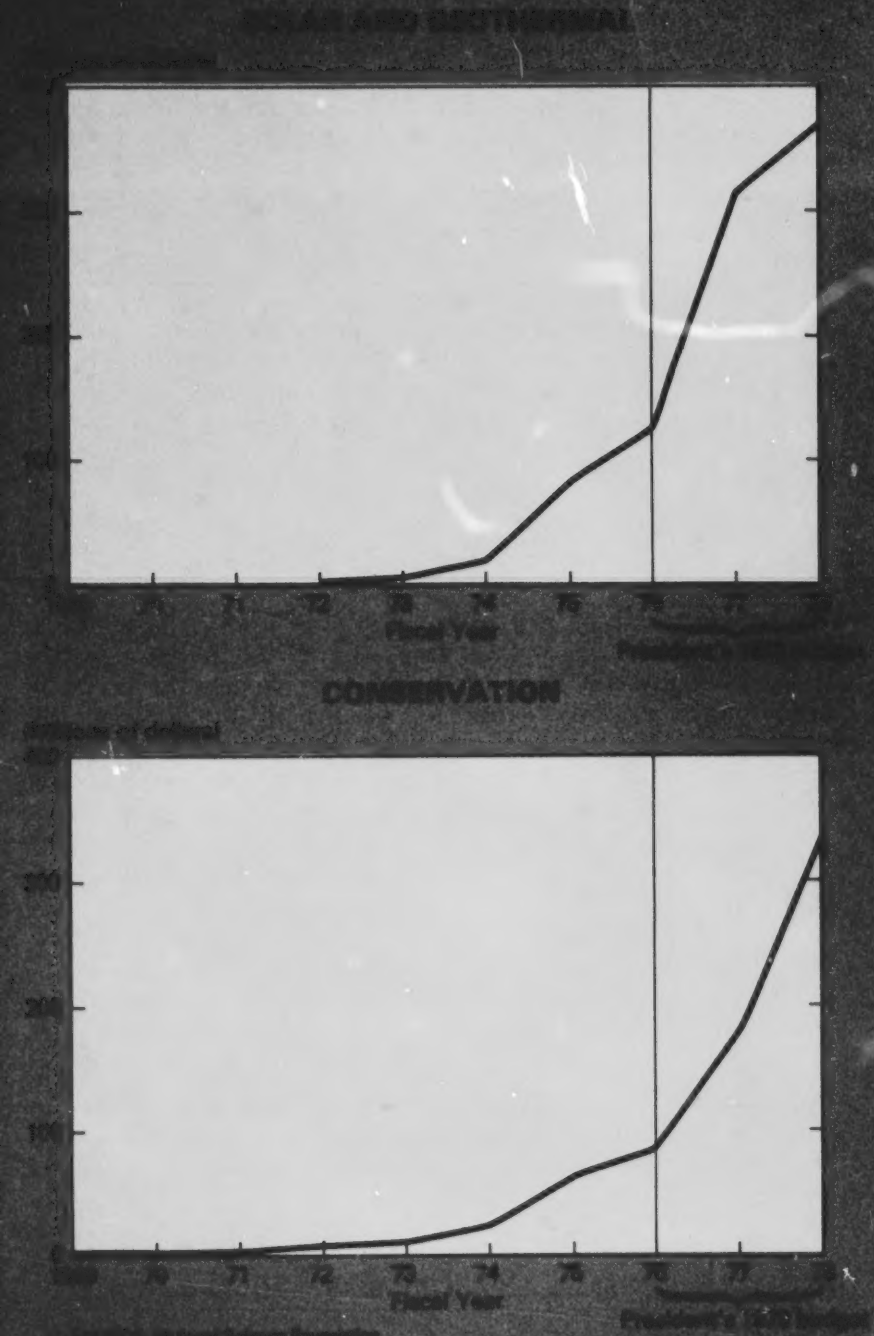
The NRC reactor safety research program was proposed for growth of 22 percent in 1978. The objective of this program is to develop analytical methods to assess the safety of nuclear power reactors. To support this program, ERDA requested funds in 1978 to continue to build experimental test facilities.[11]

- **Fossil** energy programs make up the second largest energy subfunction, accounting for one-fifth of all energy R&D obligations in 1978. ERDA coal utilization is the predominant program in this area, although a decline in funding was proposed in 1978. The overall purposes of this program are related to the conversion of coal to liquid and gaseous fuels, improved methods for the direct combustion of coal, and development of advanced power conversion systems for generating electricity from coal. Congress subsequently granted increases in direct combustion and magnetohydrodynamics, which may result in an increase in the total program.

  The ERDA petroleum and natural gas program is scheduled for a substantial increase to expand efforts toward enhanced oil and gas recovery technologies that will increase production flow rates.

  The in situ technology program of ERDA is also scheduled to increase in 1978 to provide for continued testing of promising technologies and the development of techniques for recovering oil and gas from shale.

[11] These are considered to be expendable equipment and therefore not part of R&D plant.



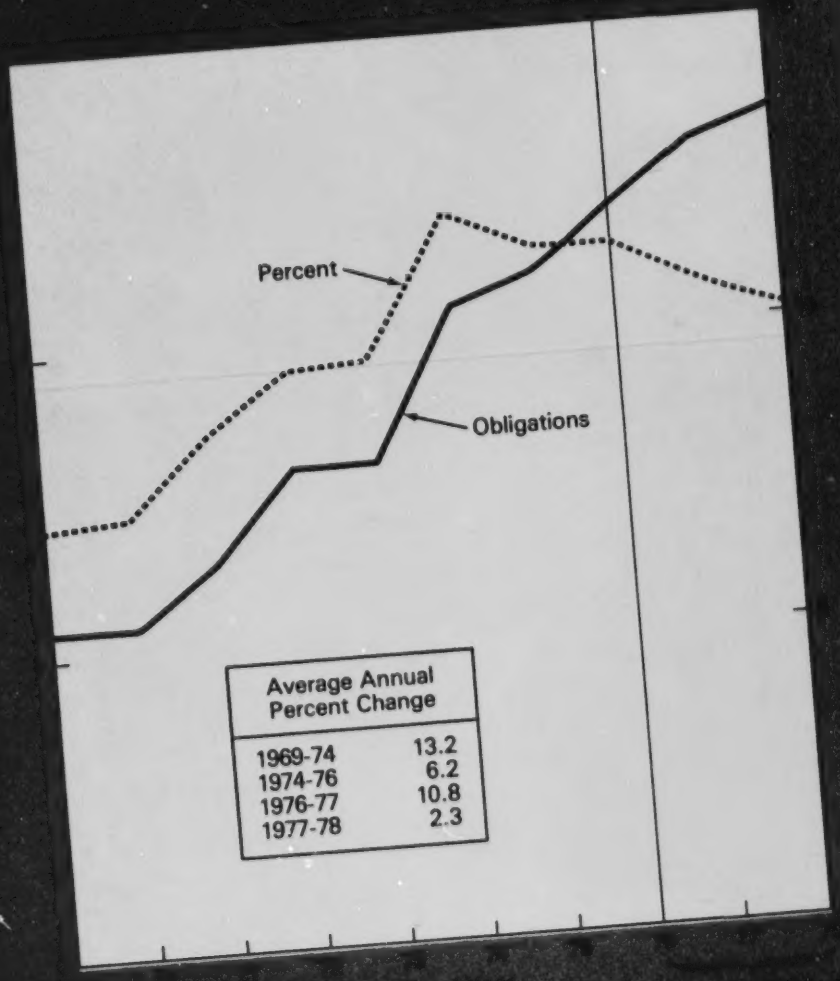
Solar and geothermal energy programs have made up a relatively new but fast-growing area of energy research and development. This subfunction accounted for 13 percent of all energy obligations in 1978, as shown in the President's budget. The ERDA solar energy development program is comprised of four subprograms: thermal application, solar electric applications, fuels from biomass, and technology support and utilization. In 1978 a substantial increase was granted by the Congress to the overall program.

The ERDA geothermal program support is also scheduled for a substantial increase in 1978. This increase will cover additional work in engineering research, hydrothermal technology applications, geopressure and hot dry rock studies, technology demonstrations, and environmental studies.

The **conservation** subfunction is the fastest growing energy area, chiefly because of growth in the ERDA program in end-use conservation and technologies to improve efficiency. In 1978 this program will more than double in order to cover research and development on energy saving in industry, building, and transportation.

Another growing conservation program is ERDA electric systems and energy storage, also scheduled for a substantial increase in 1978. Work will be directed toward resolving technical problems in regional and national bulk power systems and accomodating new electric energy production and storage technologies.

Other energy efforts in the Federal Energy Administration have been phased out, leaving only the NASA energy programs within this subfunction. NASA energy programs provide support for other Government agencies through applications of NASA aerospace technologies and capabilities.



Average Annual Percent Change	
1969-74	13.2
1974-76	6.2
1976-77	10.8
1977-78	2.3

HEALTH

- Health R&D programs, as presented in the 1978 budget, showed an increase of only 2 percent although the long-term average annual growth of this function from 1969 to 1977 was 11.1 percent.[12]

- The small size of the increase in 1978 was partly the result of a high obligational carryover to 1977, stemming from a Presidential veto of the 1976 HEW appropriation that was later overriden by the Congress midway in the fiscal year. More recent congressional action, however, has had the effect of furthering increasing the 1978 health total.

- The share of health in total Federal R&D funding has risen from 7.2 percent in 1969 to an estimated 10.7 percent in 1977 and 10.2 percent in 1978.

[12] This function excludes the environmental health component of the environment function. See p. 28.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Health, total	$1,126.8	$2,365.5	$2,622.2	$2,682.6
	Percent distribution			
Biomedical research	85.0%	91.4%	91.2%	91.5%
National Cancer Institute (NIH) (HEW)	14.7	28.6	27.8	27.6
National Heart, Lung, and Blood Institute (NIH) (HEW)	12.0	14.7	14.2	14.3
National Institute of Arthritis, Metabolism, and Digestive Diseases (NIH) (HEW)	10.4	7.3	7.6	7.6
National Institute of General Medical Sciences (NIH) (HEW)	8.0	6.1	6.1	6.7
National Institute of Neurological and Communicative Disorders and Stroke (NIH) (HEW)	9.1	5.6	5.6	5.8
National Institute of Allergy and Infectious Diseases (NIH) (HEW)	7.0	5.0	5.1	5.5
National Institute of Child Health and Human Development (NIH) (HEW)	5.1	5.3	5.2	5.4
Medical and prosthetic research (VA)	4.5	4.1	4.2	4.1
Division of Research Resources (NIH) (HEW)	7.1	5.5	5.2	3.8
National Eye Institute (NIH) (HEW)	([2])	1.9	2.3	2.3
National Institute of Environmental Health Sciences (NIH) (HEW)	1.2	1.5	1.8	2.1
National Institute of Dental Research (NIH) (HEW)	1.9	1.9	1.9	2.0
National Institute of Aging (NIH) (HEW)	([3])	.7	1.1	1.2
Disease control (CDC) (HEW)	1.4	.8	.8	.7
Office of the Director (NIH) (HEW)	–	.7	.6	.6
Drugs and devices (FDA) (HEW)	.7	.5	.6	.6
National Center for Toxicological Research (FDA) (HEW)	–	.4	.4	.4
Other	1.8	.8	.9	.8
Mental health	8.9%	4.0%	4.1%	4.0%
Mental health research (ADAMHA) (HEW)	8.9	4.0	4.1	4.0
Delivery of health care	4.7	2.7	2.8	2.6
Health services research (HRA) (HEW)	3.7	1.4	1.1	1.2
Rural health and health care demonstration (SRS) (HEW)	–	.5	.8	.8
Maternal and child health services (HSA) (HEW)	.6	.2	.2	.2
Patient care and special health services (HSA) (HEW)	.2	.1	.1	.1
Family planning services (HSA) (HEW)	–	.1	.1	.1
Other	.3	.4	.4	.2
Drug abuse prevention and rehabilitation	1.4	2.0	1.8	1.8
Drug abuse research (ADAMHA) (HEW)	.9	1.4	1.3	1.3
Alcoholism research (ADAMHA) (HEW)	.4	.5	.5	.5
Other	–	([4])	([4])	([4])

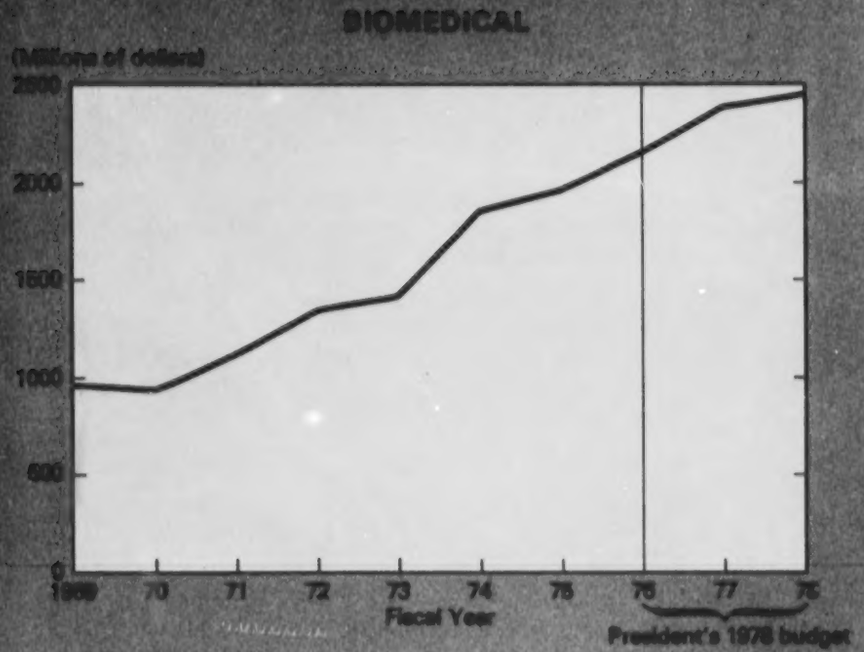
[1] Estimates based on the President's 1978 budget to Congress.

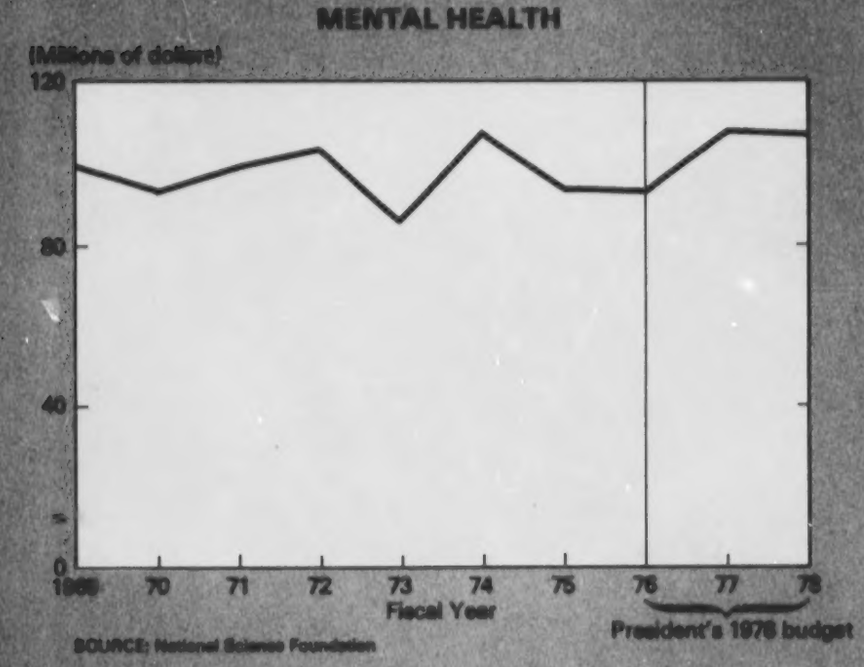
[2] Included within the National Institute of Neurological and Communicative Disorders and Stroke.

[3] Included within the National Institute of Child Health and Human Development.

[4] Less than 0.05 percent.

SOURCE: National Science Foundation





Comments

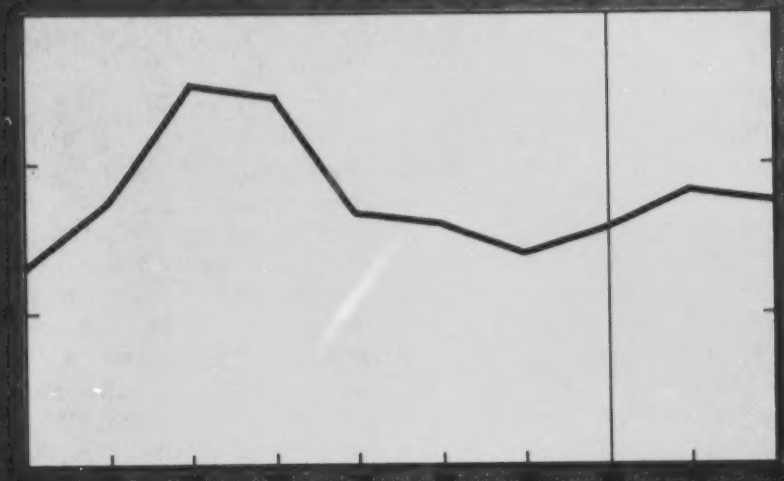
- **Biomedical research** accounts for the predominant share of funding for the health R&D total—92 percent in 1978. This subfunction expanded more rapidly than the overall health function between 1970 and 1977, offsetting slower growth in most other health program areas.

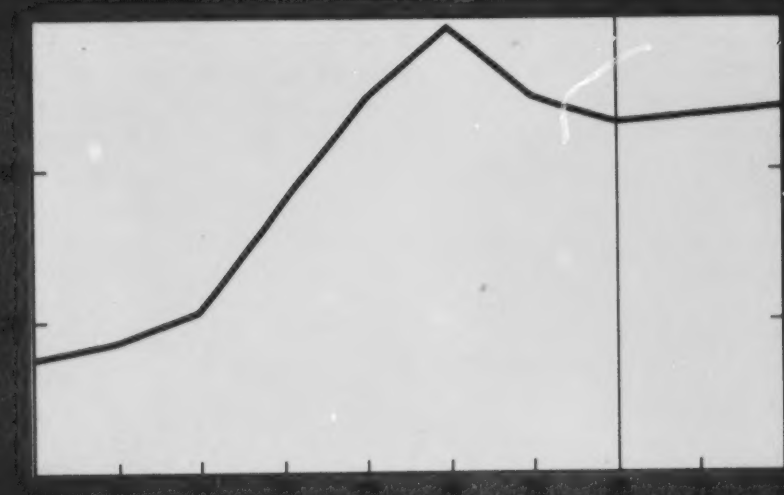
  The National Institutes of Health (NIH) provide more than nine-tenths of the R&D activity under the biomedical research subfunction. Between 1969 and 1976 support for cancer research and for heart and lung research grew faster than for any of the other NIH programs—at average annual rates of 22.0 percent and 14.3 percent, respectively, while growth in research for the rest of the institutes collectively was 8.2 percent. In 1977, however, the increase for cancer and for heart and lung research was 8 percent in each case, at the same time that the relative increase for each of the other institutes was greater (with one exception). Research on aging increased 59 percent; environmental health problems, 34 percent; eye diseases, 31 percent; and arthritis, metabolism, and digestive diseases, 15 percent.

  Although small relative increases were requested for cancer and heart and lung research in 1978 in the President's budget, congressional action raised the levels of these programs while simultaneously giving greater relative increases to all the other institutes, especially to research in eye problems, in aging, in environmental health, and in arthritis and metabolism. The 25-percent decline in funds for the Division of Research Resources in the 1978 budget reflected the proposed phaseout of the biomedical research support grants program. This program was restored by the Congress, however.

  Other biomedical research activities are represented chiefly by medical and prosthetic programs of the Veterans Administration, scheduled to stay at the same level in 1978; R&D activities of the Center for Disease Control (HEW), expected to decline somewhat; and the drug and devices and the toxicological programs of the Food and Drug Administration (HEW), expected to increase.

- **Mental health** shows a decline in the share of the health R&D total from 9 percent in 1969 to an estimated 4 percent in 1978. The proposed 1978 support level was only 7 percent higher than in





1969, but congressional action increased mental health research support above the agency request.

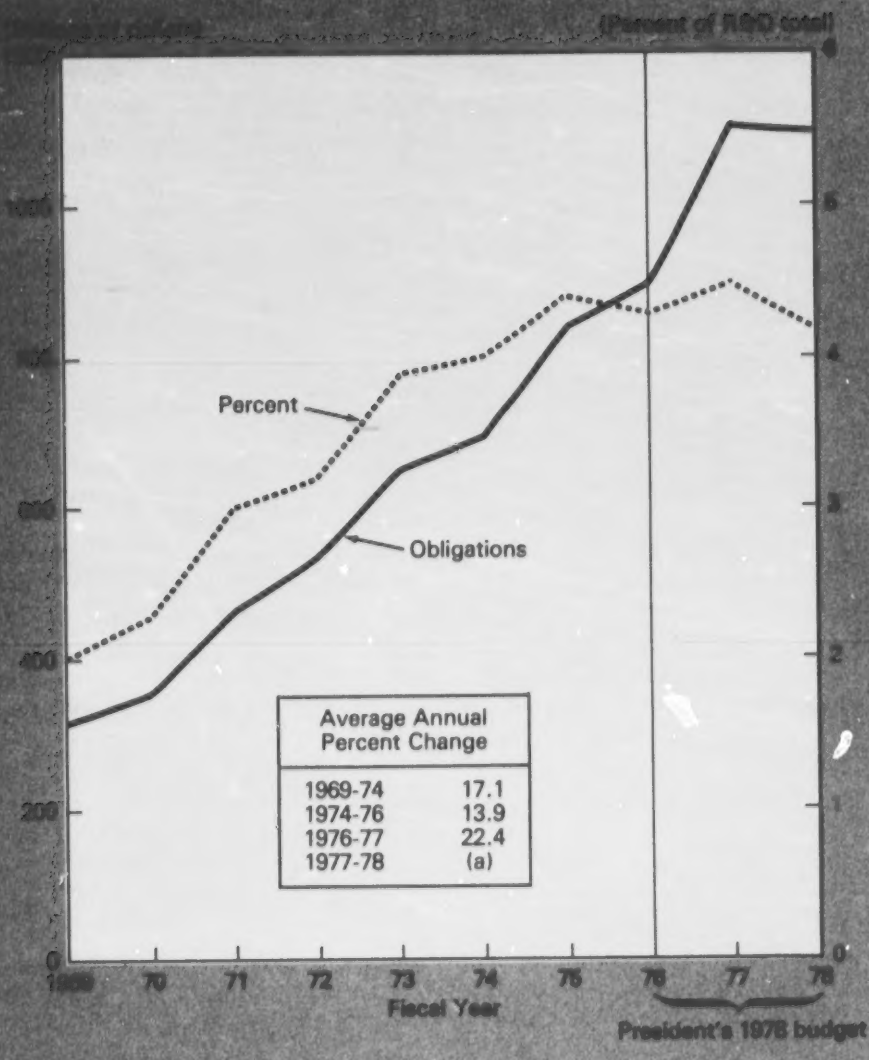
The National Institute of Mental Health in the HEW Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA) sponsors all the R&D activity in this area. The Institute funds general mental health research, concentrating at present on schizophrenia, depression, and mental disorders of children.

- **Delivery of health care** shows a 4-percent decrease in 1978. The share of this subfunction in the health R&D total has fallen from 5 percent to 3 percent in the 1969-78 period.

  Health services research and evaluation in the Health Resources Administration (HRA) in HEW is the main program under delivery of health care. This program is committed to research for improving the organization, delivery, quality, and financing of health services. The next largest program is concerned with rural health and health care demonstrations under the sponsorship of the Social and Rehabilitation Service (HEW).

  Other programs under delivery of health care include mental and child health services, patient care and special health services, emergency health services, and family planning services, all within HRA.

- **Drug abuse prevention and rehabilitation** shows no significant change in support in 1978, with funding still well below the leak level of 1974. This subfunction grew rapidly from 1969 to 1974, but declined in 1975 and has changed little since then. The major programs under this subfunction are the drug abuse research program and the alcoholism research program, both within ADAMHA. Funding for these two activities scarcely changes in 1978 from 1977.



[A] decrease of less than 0.05 percent.
SOURCE: National Science Foundation

ENVIRONMENT

- The environment function displays no overall growth in 1978, although in emphasis shifts among programs and subfunction are evident. Growth over the 1969-77 period, however, was rapid, at an average annual rate of 16.9 percent.

- Federal support of environmental R&D activities is widespread and dispersed, with every major R&D funding agency involved in environmental efforts.[13]

- The environment share of total Federal R&D support has risen from 2.0 percent in 1969 to an estimated 4.5 percent in 1977 and 4.2 percent in 1978.

[13] The natural resources function also contains a large number of programs, and many of these could logically be placed in either that or the environment category. A guiding principle was established of assigning programs primarily devoted to studying, inventorying, and managing resources to natural resources, and assigning those primarily devoted to studying interactions within systems or studying the nature of pollutants and their effects on living systems to environment.

Trends in R&D Programs

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Environment, total	$315.2	$899.4	$1,100.7	$1,098.3
	Percent distribution			
Environmental health and safety	38.1%	40.8%	38.8%	40.9%
Environmental R&D (ERDA)	28.4	15.1	14.6	16.9
Life sciences research and biomedical applications (ERDA)		4.4	4.0	3.5
Pollution effects research (EPA)	([2])	8.7	8.1	7.6
Occupational safety and health (CDC) (HEW)	4.8	3.5	3.5	3.7
Health and safety research (Bu. Mines) (Interior)	.7	3.8	3.2	3.2
Environmental and fuel cycle research (NRC)	–	.8	1.2	1.5
Food safety research (FDA) (HEW)	NA	1.1	1.0	1.1
Human health and safety (ARS) (USDA)	2.7	1.0	.9	1.0
Other	1.5	2.3	2.2	2.3
Pollution control and environmental protection	25.6	30.3	35.1	31.9
Water quality control (EPA)	[3]10.7	6.5	7.3	6.2
Energy-related environmental control programs (EPA)	–	5.9	8.1	6.1
Air quality control (EPA)	[3]10.2	4.2	4.7	3.8
Nuclear materials security and safeguards (ERDA)	.8	1.3	2.5	3.5
Environmental quality monitoring (NASA)	–	3.5	3.5	3.4
Interdisciplinary studies (EPA)	–	2.1	2.7	2.1
Other	3.9	6.8	6.4	6.7
Understanding, describing, and predicting the environment	36.4	29.0	26.1	27.2
Environmental satellite programs (NASA)	23.3	11.2	9.3	7.2
Weather and climate	NA	6.4	4.7	3.8
Ocean condition	NA	3.5	4.0	2.4
Earth dynamics	NA	1.3	.6	1.0
Environment programs (NOAA) (Commerce)	7.3	6.0	5.1	5.2
U.S. Antarctic Research program	2.2	3.6	4.3	4.5
Mapping of earthquake hazards and earthquake prediction (GS) (Interior)	.4	1.4	1.1	2.5
Earthquake engineering (NSF)	–	.8	.9	1.9
Other environment related programs (NSF)	1.2	2.6	2.3	2.4
Other environment related programs (NOAA) (Commerce)	.9	2.2	2.0	2.2
Other	1.1	1.2	1.3	1.3

[1] Estimates based on the President's 1978 budget to Congress.

[2] Included under EPA pollution control and environmental protection.

[3] Includes environmental health portion of EPA program, which cannot be separately identified prior to 1972.

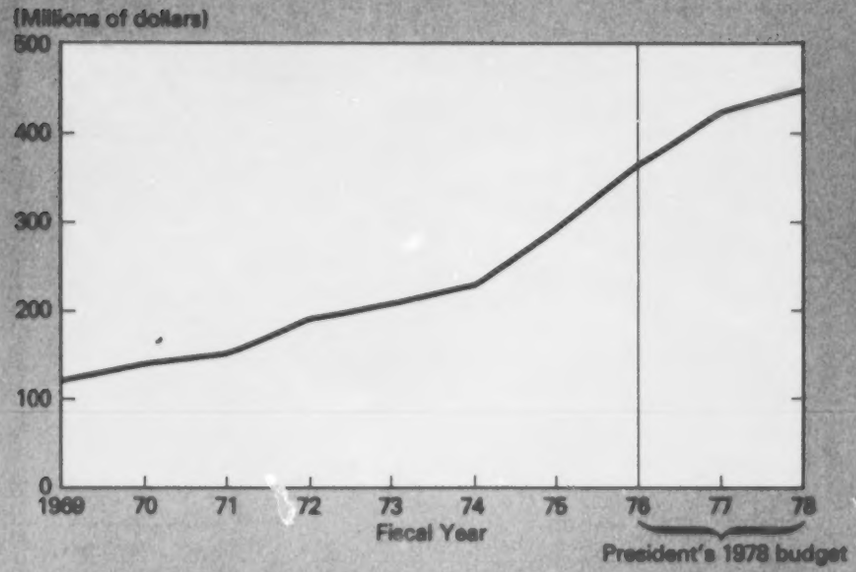
SOURCE: National Science Foundation

Comments

- The **environmental health and safety** subfunction remains the most heavily funded area within the environment function, accounting for more than two-fifths of the total in 1978. The increased support accruing to this subfunction is caused by continued expansion in the ERDA environmental R&D program, the largest within the environment function. This program, designed to assure the environmental acceptability of energy technologies under development, is scheduled to expand considerably in 1978, continuing growth that has been uninterrupted since 1969. The 1978 increase covers characterization studies of nonnuclear-energy-related pollutants and their effects on animal and human life.

  The ERDA life sciences research and biomedical applications program was separated from the ERDA environmental R&D program in the current budget (1976-78) reporting period. The life sciences program carries out research not related to any specific energy technology. The main interest is the study of living systems upset by physical or chemical agents and the development of isotope probes for detecting human pathological changes. The decrease in 1978 results from the transfer of the artificial heart program.

ENVIRONMENTAL HEALTH AND SAFETY



SOURCE: National Science Foundation

EPA pollution effects research covers eight programs, each concentrating on a specific medium or pollutant. Even though 1978 funding declined in the budget request, R&D support will still have increased almost five times since 1972 when these programs were first reported. The indicated 1978 decline was largely the result of a carryover of obligations into 1977. The three largest programs are energy-related environmental effects research, water quality effects research, and air quality effects research.

The National Institute for Occupational Safety and Health (NIOSH) within the HEW Center for Disease Control provides the research base for Federal efforts to assure healthful and safe working conditions. The 1978 level is moderately higher than 1977.

The health and safety research program of the Bureau of Mines has remained at about the same funding level since 1972, but some increase will be shown in 1978. Under this program research is conducted to assure a safer environment and working conditions for miners and to reduce health hazards to mine workers.

NRC environmental and fuel cycle research began in 1975 and was set for growth in the 1978 budget request that would put funding at six and one-half times the original level. This program provides technical information for the development of regulatory guidelines and standards.

The HEW Food and Drug Administration (FDA) sponsors a food safety research program covering the toxicology of environmental chemicals, and the USDA Agricultural Research Service (ARS) supports a human health and safety research program to assure that foods are free from toxic substances. Both showed increased support in the 1978 budget.

Other programs within the environmental health subfunction include radiological products research by FDA, fire-related R&D efforts by the National Fire Prevention and Control Administration (Commerce), and work of the Consumer Product Safety Commission.

- **Pollution control and environmental protection** displayed a 9-percent drop in funding proposed for 1978 but with support still at 29 percent above the 1976 level. The decline mainly resulted from lower levels shown for most of the nine EPA pollution control programs, stemming from a large carryover of obligations into 1977.

  The largest EPA program is water quality control, which includes R&D efforts devoted to improving monitoring methods, establishing cost-effective waste water treatment technology, and developing strategies for controlling pollution from different sources.

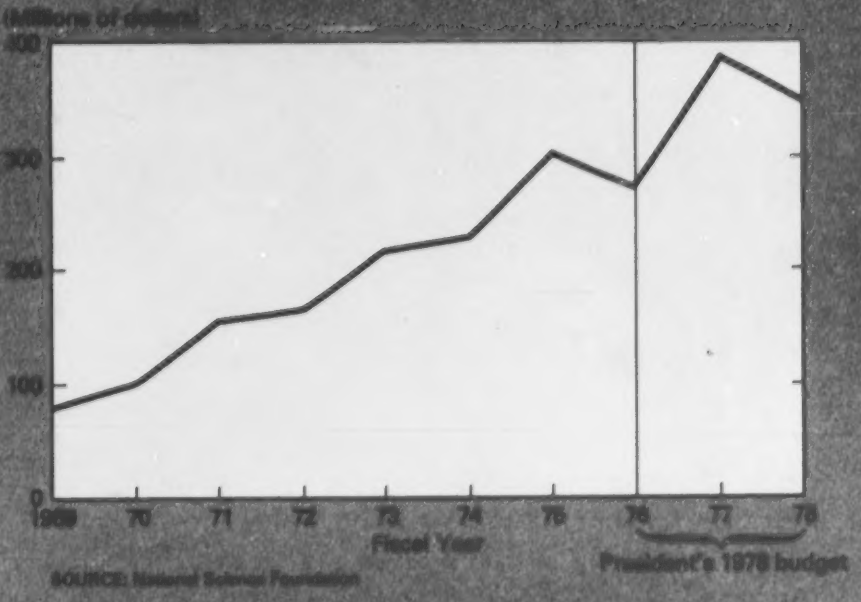
  A second EPA program, almost as large, focuses on protecting the environment from adverse effects of energy systems. This program provides a data base for the establishment of regulations and incentives toward environmentally acceptable practices as well as environmental control options for extraction, processing, and utilization practices that cause environmental damage.

  The EPA air quality control program concentrates on data accumulation and technology development for establishing prudent regulations and controls for limiting air pollution.

  ERDA nuclear materials security and safeguards R&D obligations were to increase by 38 percent in 1978 in the budget proposal, and no change was made by the Congress. This program is directed toward designing integrated safeguard systems for nuclear power fuel cycle facilities and evaluating the level of control and the cost-effectiveness of these systems. The 1978 increase will support further safeguard assessment and testing or protective technology.

  NASA environmental quality monitoring covers work on Nimbus-G, an experimental air and water pollution monitoring satellite, scheduled for launch in 1978, and on the stratospheric aerosol and gas experiment project designed to measure atmospheric constituents. A small decrease in funding is scheduled in 1978.

  Other pollution control and environmental protection programs include EPA efforts in solid waste management, interdisciplinary studies, pesticides, and toxic substances control, DOT programs in pollution control and abatement, and several other programs of NSF and DOD.



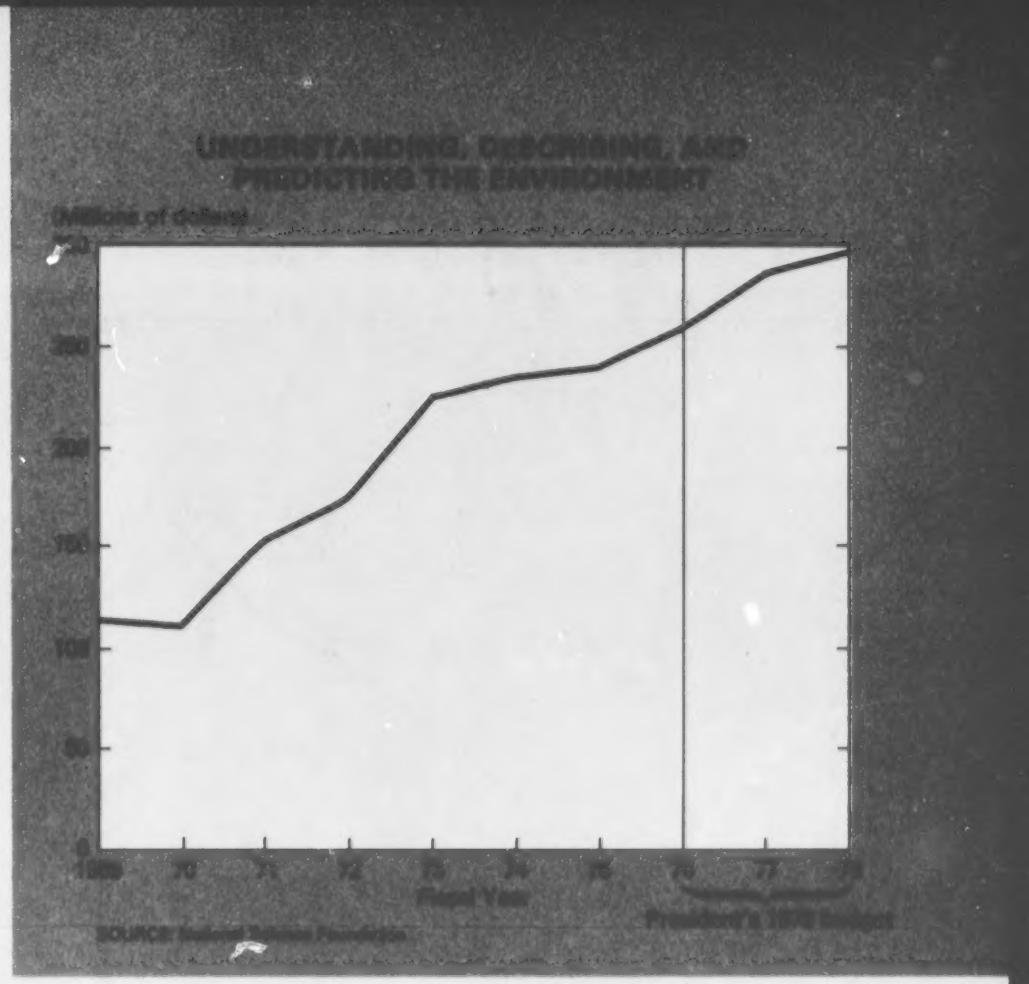
- **Understanding, describing, and predicting the environment** showed a small increase in the 1978 budget and will account for more than one-fourth of the total R&D support within environment.

  The NASA environmental satellite programs consist of three efforts that together are scheduled for a considerable drop in funding in 1978. The largest NASA program, weather and climate observation and forecasting, shows a decrease in 1978 as development of the Tiros-N meteorological satellite moves toward launching. This new satellite will play an important role in obtaining data for the first global atmospheric research program experiment. The ocean condition monitoring and forecasting program is expected to receive a larger cutback in obligations in 1978 as development of the Seasat-A satellite also progresses toward launch. The third NASA program, earth dynamics monitoring and forecasting, shows increased funding. This program will focus on geodesy and a future earthquake prediction capability.

  The National Oceanic and Atmospheric Administration (NOAA) within Commerce supports a group of eight programs that are subsumed under the environment heading. These show little growth for 1978. They are basic environmental services, public forecast and warning services, specialized environmental services, weather modification, environmental data and information services, global monitoring of climatic change, maritime technology, and mapping, charting and surveying services.

  The U.S. Antarctic research program, sponsored by NSF, accounts for about one-sixth of the funding under this subfunction. This program has increased in funding every year since 1969 and is scheduled to expand by 4 percent in 1978. NSF has been assigned responsibility for planning, funding, and implementing the national program in Antarctica. Scientific efforts are centered on environmental and research-related studies.

  Mapping of earthquake geologic hazards and earthquake prediction on the part of the Geological Survey (Interior) was planned to more than double in obligations in the 1978 budget. Efforts are concentrated on developing basic data on geologic principles and processes, and especially on terrain and foundation conditions related to earthquakes.

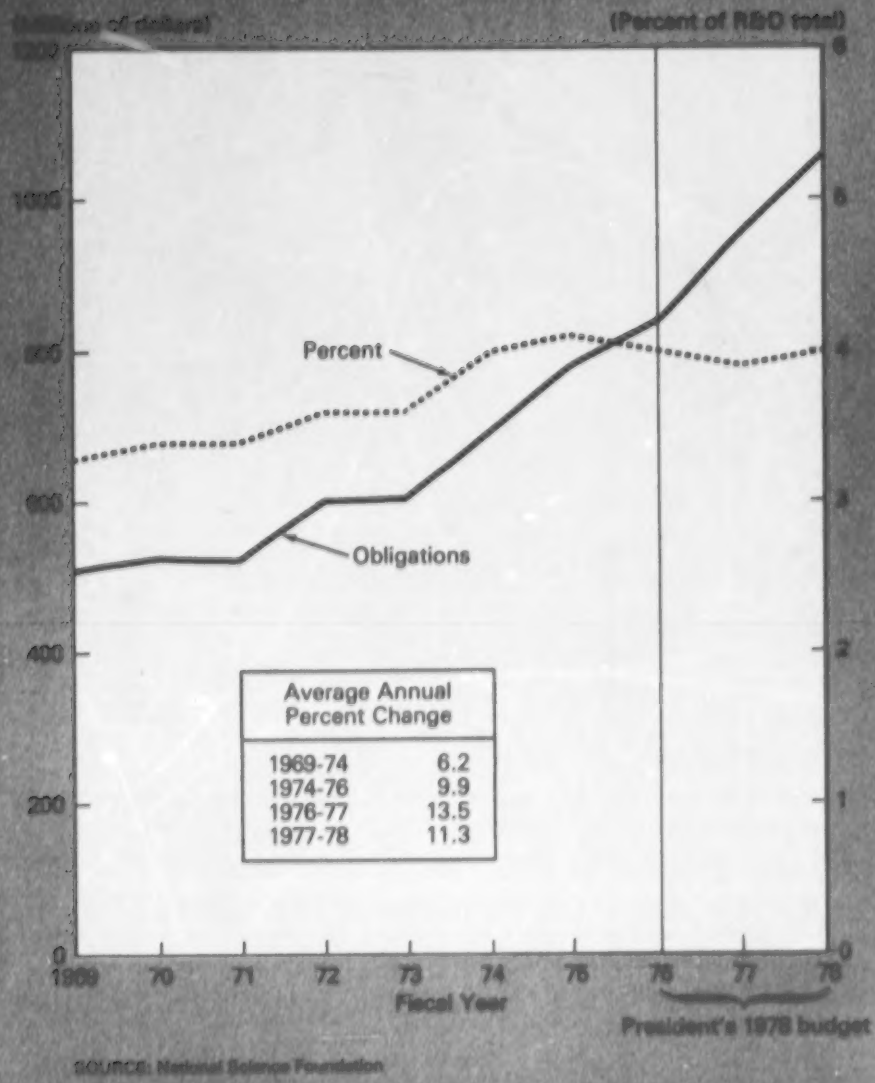


NSF is sponsoring a complementary program in earthquake engineering. With a 1978 requested level more than double that of 1977, this program is directed toward intensified efforts to mitigate earthquake hazards.

Other NSF efforts show small increases for 1978. These efforts address climate dynamics, environmental forecasting, Arctic research, weather modification, fire research, and social response to natural hazards.

Other NOAA programs cover marine ecosystems investigations, environmental satellite services, and international projects.

SCIENCE AND TECHNOLOGY BASE



- Science and technology base reflects a relatively high growth of 11 percent in the 1978 budget. The average annual rate of growth between 1969 and 1977 was 8.0 percent, mostly based on a strong rising trend that began in 1974.

- This function covers support to basic research in the various fields of science, as well as some applied research. R&D programs included under this heading are those that support science and the growth of a technology base with broad applications that can extend beyond the mission of a sponsoring agency.

- In 1969 the share of science and technology base in the Federal R&D total was 3.3 percent, and in 1977 it was 3.9 percent and was expected to be 4.0 percent in 1978.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Science and technology base, total	$513.5	$839.2	$952.6	$1,059.9
	Percent distribution			
High-energy physics (ERDA)	23.1%	18.3%	17.8%	17.7%
Basic energy sciences (ERDA)	25.0	13.5	13.5	13.9
Nuclear physics (ERDA)		6.5	6.8	6.5
Physiology, cellular and molecular biology research project support (NSF)	5.4	5.6	5.7	5.9
Physics research project support (NSF)	5.0	5.7	6.0	5.8
Materials research project support (NSF)	1.5	5.8	5.7	5.5
National Research Centers (NSF)	4.8	4.8	4.5	5.0
Engineering research project support (NSF)	3.1	4.5	4.4	4.2
Chemistry research project support (NSF)	3.5	3.8	3.8	3.8
Environmental biology research project support (NSF)	1.4	3.4	3.4	3.4
Basic research support (Smithsonian)	2.9	3.1	3.2	3.0
Behavioral and neural sciences research project support (NSF)	1.6	2.5	2.6	2.8
Social sciences research project support (NSF)	2.1	2.4	2.4	2.4
Mathematical sciences research project support (NSF)	2.5	2.2	2.2	2.2
Basis for national physical measurement system (NBS) (Commerce)	3.2	2.4	2.4	2.0
Materials processing in space (NASA)	–	1.0	1.3	2.0
Earth sciences research project support (NSF)	1.5	2.0	1.8	2.0
Oceanography research project support (NSF)	2.1	2.0	2.0	1.9
Atmospheric sciences research project support (NSF)	1.6	1.8	2.0	1.9
Oceanographic facilities operations support (NSF)	1.7	1.9	1.9	1.7
Computer research project support (NSF)	2.2	1.7	1.6	1.6
Astronomy research project support (NSF)	1.3	1.2	1.3	1.4
Ocean sediment coring program (NSF)	.5	1.5	1.4	1.3
Other	4.0	2.6	2.0	1.9

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

- The high-energy physics program of ERDA accounts for almost one-fifth of the science and technology base function in 1978. The primary goal of this program is to gain an understanding of the fundamental nature of matter and energy and the laws that govern their behavior. The conduct of high-energy physics research depends primarily upon the utilization of four accelerator facilities and one colliding-beam facility. With an 11-percent rise in funding scheduled for 1978, the program will place increased emphasis on better use of the unique capabilities that exist at these laboratory facilities.

  Another ERDA program, basic energy sciences, is next in size of support. The objective of this program is to develop scientific understanding of physical phenomena basic to the energy technologies of all ERDA programs. A scheduled 1978 increase of 16 percent will be largely used to sustain ongoing studies in the materials and molecular sciences.

  The third largest science and technology base program in 1978 is in the area of nuclear physics. This program, also supported by ERDA, is concerned with advanced experimental and theoretical studies of the properties and dynamics of atomic nuclei and the characterization of the strong force that governs the interaction between nucleons. A small relative increase is scheduled for this program in 1978.

NSF research project support programs are aimed at providing the Nation with a strong scientific capability and an expanding base of scientific knowledge. The physiology, cellular molecular biology program is the largest of the 14 research project areas supported by this agency. In 1978, however, almost as much support is given to physics and to materials research as is given to the physiology area. All three of these areas are scheduled for substantial increases in 1978.

On a collective basis, the funding level of the six National Research Centers supported by NSF is expected to rise substantially in 1978. The National Radio Astronomy Observatory and the National Astronomy and Ionosphere Center are expected to show relatively large increases. The National Center for Atmospheric Research, however, is the largest in total support.

Other NSF research project support areas include engineering, chemistry, and environmental biology, to name the larger ones. All of these are scheduled for increases in 1978, as are the rest of the basic research fields supported by NSF.

The Smithsonian Institution concentrates basic research efforts in the fields of biology, astronomy, anthropology, and the environ-

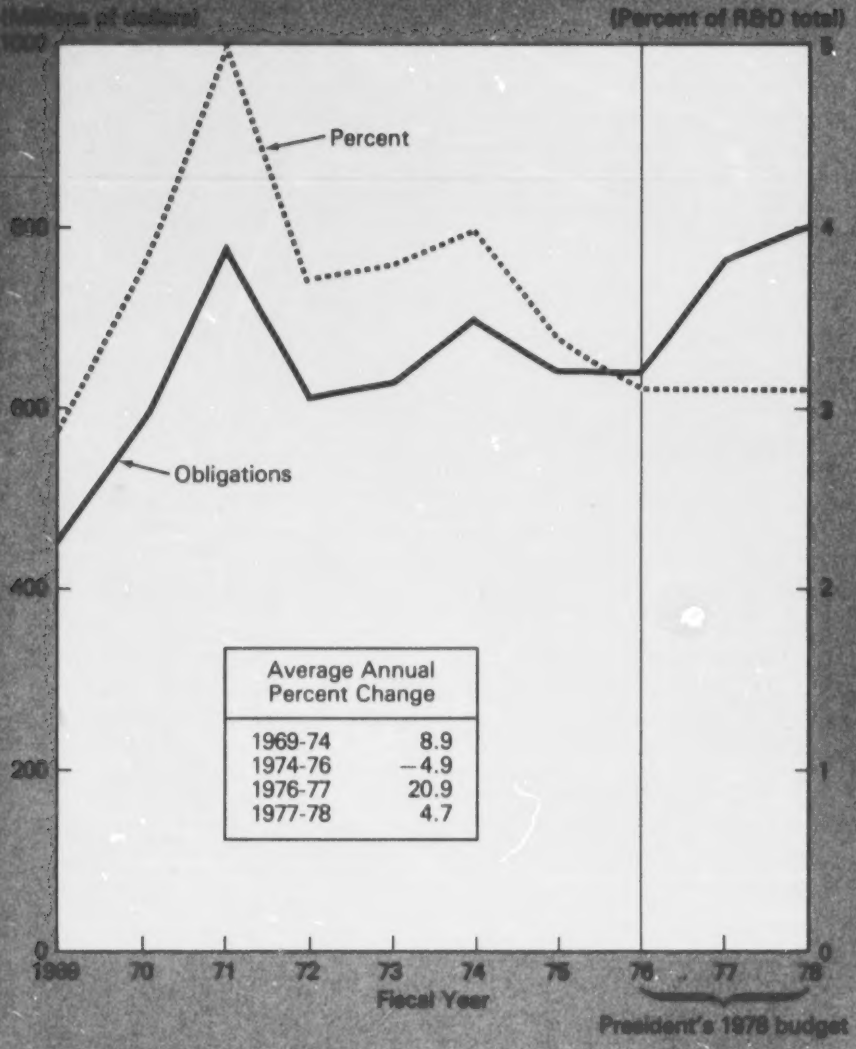
mental sciences (geology, oceanography, and the atmospheric sciences). Overall support in 1978 was increased 5 percent in the President's budget.

The National Bureau of Standards (Commerce) has for many years conducted research and development to ensure that users of science and technology in the United States will be able to make physical measurements with the required accuracy, yielding the same results over time, and reconcilable with other like measurements made elsewhere. A moderate decrease in the overall program was proposed in 1978.

An increase of 68 percent was requested for the NASA program on materials processing in space. Particular emphasis will be placed on the potential applications of biological and crystal growth processing.

The remaining programs within science and technology base include some specially targeted NSF programs, such as oceanographic facilities operations support, the ocean sediment and coring program and science information, as well as patent activities within Commerce.

...ORTATION AND COMMUNICATIONS
FEDERAL R&D OBLIGATIONS



SOURCE: National Science Foundation

TRANSPORTATION AND COMMUNICATIONS

- In 1977 and again in 1978 funding for transportation and communications R&D programs was expected to reverse the downward trend of 1975 and 1976 and show an increase. The increase requested for 1978 was 5 percent.

- Despite some wide year-to-year fluctuations, the average annual growth rate for this function was 6.7 percent between 1969 and 1977, slightly ahead of the average rate of all Federal programs.

- The transportation and communications share of the Federal R&D total has remained relatively constant in the last few years. The ratio was an estimated 3.1 percent in 1977 and the same ratio is expected in 1978, compared with 2.9 percent in 1969. The share rose to 5.0 percent in 1971, the year the SST program was terminated.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Transportation and communications, total	$458.1	$635.7	$768.8	$804.8
	Percent distribution			
Air	68.9%	63.9%	57.9%	60.9%
Aeronautical research and technology (NASA)	38.9	49.8	44.3	47.4
Air traffic control (FAA) (DOT)	5.7	6.5	7.7	8.4
Other air transportation R&D (FAA) (DOT)	2.9	3.9	3.9	3.7
Navigation (FAA) (DOT)	.9	3.6	2.0	1.3
Civil Aeronautics Board	([2])	.1	.1	.1
Civil supersonic aircraft (DOT)	20.5	—	—	—
Ground	15.3	24.5	30.1	27.1
Urban Mass Transportation Administration (DOT)	4.0	7.3	7.6	8.6
Federal Highway Administration (DOT)	6.4	4.4	6.9	6.6
National Highway Traffic Safety Administration (DOT)	2.4	4.9	7.7	6.4
Railroad research (FRA) (DOT)	([2])	7.9	8.0	5.5
High-speed ground transportation R&D (FRA) (DOT)	2.5			
Water	5.4	4.1	4.3	3.8
Maritime Administration (Commerce)	1.8	3.0	2.3	2.0
Coast Guard (DOT)	3.6	1.1	2.0	1.8
Multimodal	.9	3.1	3.5	3.0
Office of the Secretary (DOT)	.9	3.1	3.5	3.0
Communications	9.4	4.4	4.1	5.2
Space communications (NASA)	9.2	2.9	2.8	3.9
Other	.2	1.5	1.3	1.3

[1] Estimates based on the President's 1978 budget to Congress.

[2] Less than 0.05 percent.

SOURCE: National Science Foundation

Comments

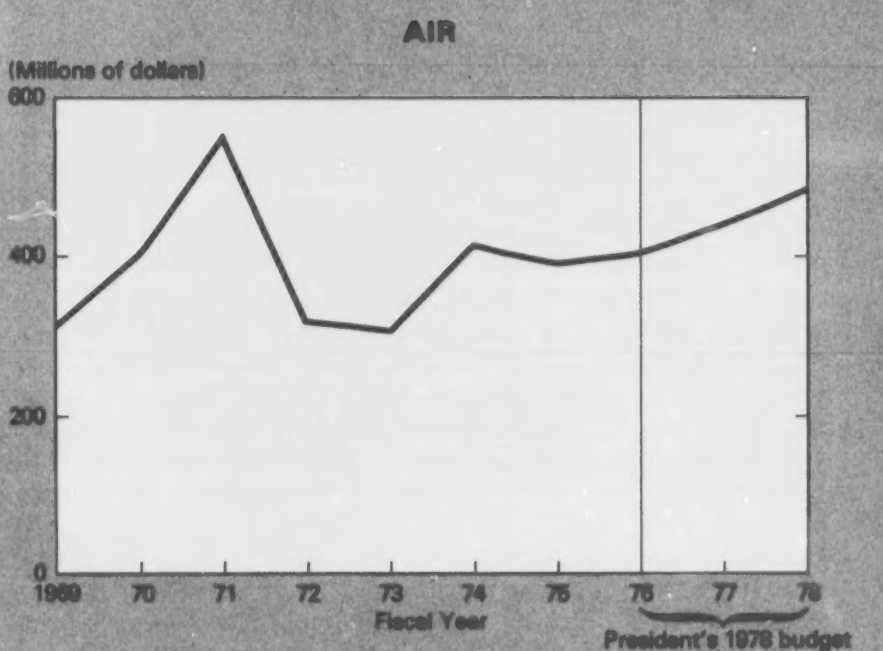
- The **air** subfunction has remained the most heavily funded area throughout the 1969-78 period and represents three-fifths of the transportation and communications total in 1978. The NASA aeronautical research and technology program continues to be the major activity and accounted for most of the 10-percent increase requested for the air subfunction in 1978. This program comprises almost one-half of the funding for the entire transportation and communications function.

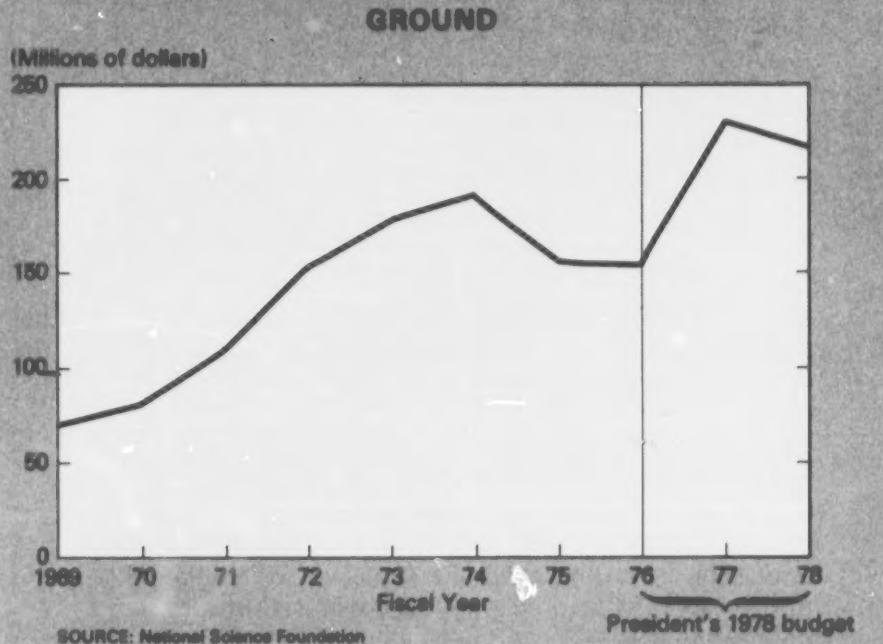
  The emphasis of this program is on aircraft efficiency and performance, both civil and military. The increase in 1978 is primarily for development of technology, by 1985, to reduce fuel consumption in commercial transports and for support for fundamental studies in aeronautics. Chief areas of concern in the overall program are reduction of energy requirements, improvement of performance, reduction of noise and pollution, improvement of safety, and advancement of long-haul and short-haul air transportation concepts.

  The three next programs in size of funding are sponsored by the Federal Aviation Administration (FAA) within DOT. The largest, air traffic control, supports the improvement of air traffic control technology, including the processing of radar tracking and other flight information and the development of computer systems to increase the capacity of major airports. Two smaller programs cover efforts to modernize and expand navigation aids and activities to promote flight safety.

- **Ground** transportation R&D programs account for more than one-fourth of the transportation and communications total in 1978. Although support for this area in 1978 was requested at a level 6 percent below 1977, funding is still well above that of 1976. The 1978 decline is primarily the result of unusually high funding in 1977 because of a carryover of obligations from 1976 for most of the DOT programs that make up this function.

  Support to the DOT Urban Mass Transportation Administration (UMTA), the largest program area, reflected the greatest growth in the 1978 budget request of any ground transportation program. Major emphasis will be on automated guideway transit systems,





SOURCE: National Science Foundation

37

which include prototype development of group rapid transit and demonstration of the downtown people mover, and service and methods demonstrations, which cover traffic management, para-transit pricing policy, and transportation for the disadvantaged.

R&D support for the DOT Federal Highway Administration (FHWA) is expected to remain at the 1977 level. Research and development cover highway planning, design, construction, operations, and highway and motor carrier safety.

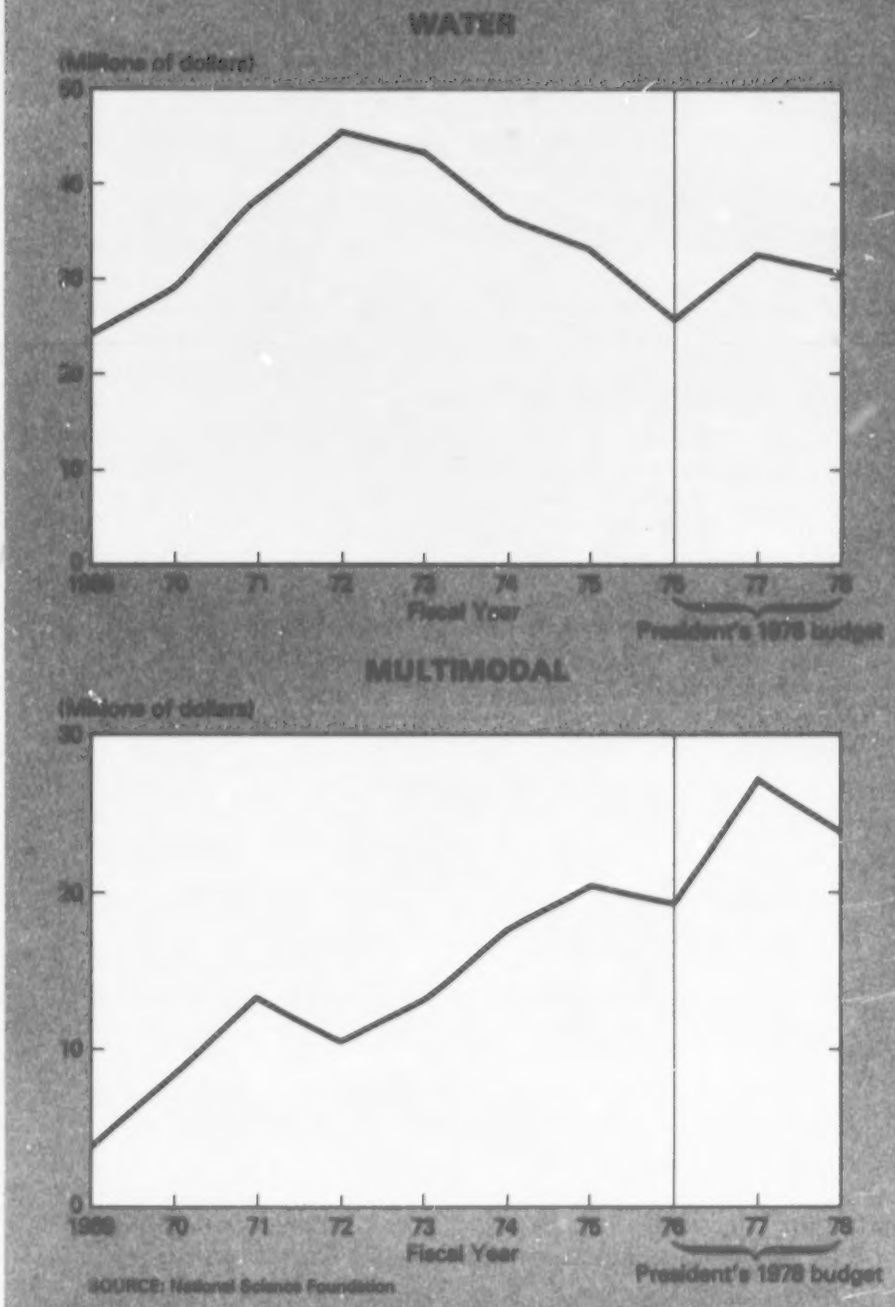
Although the R&D programs of the DOT National Highway Traffic Safety Administration (NHTSA) were set in the budget request to decline 13 percent in 1978, funding will be considerably higher than the levels of 1975 and 1976. NHTSA activities involve motor vehicle and highway safety research and development, including improvement of accident investigation data and research on vehicle safety.

R&D efforts of the DOT Federal Railroad Administration (FRA) showed considerably less support in 1978 as a result of the carryover of funds into 1977. FRA will emphasize improved rail freight and passenger services and rail safety research, including equipment and human factor failure.

- Support for **water** transportation R&D programs was expected to decline 7 percent in 1978, in the President's budget, continuing a trend of reduced funding since the 1972 high.

  The Maritime Administration (Commerce) is the source of more than one-half of the obligations for water transportation R&D support. In 1978 major efforts are directed toward increasing the productivity of U.S. shipyards and ship machinery, improving the operations of U.S. flagships, and supporting maritime research and technology developments.

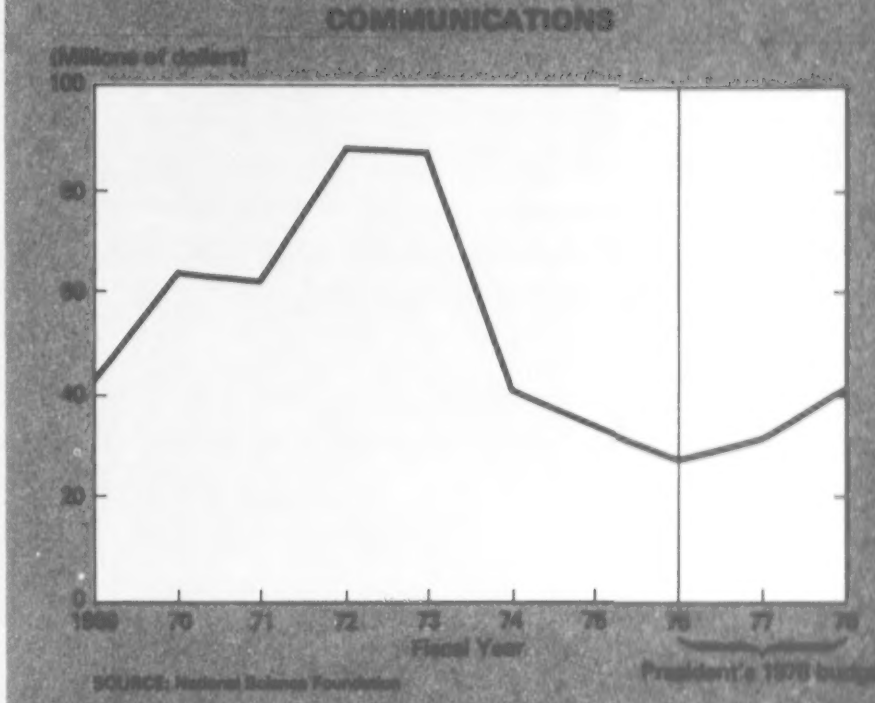
  The U.S. Coast Guard (DOT) is the only other agency classified under the water subfunction. R&D funding by the Coast Guard is focused mainly on marine safety. Other programs include R&D efforts to improve search and rescue operation effectiveness, to aid development of navigation techniques and equipment, and to improve ocean operations, particularly in ice-breaking.



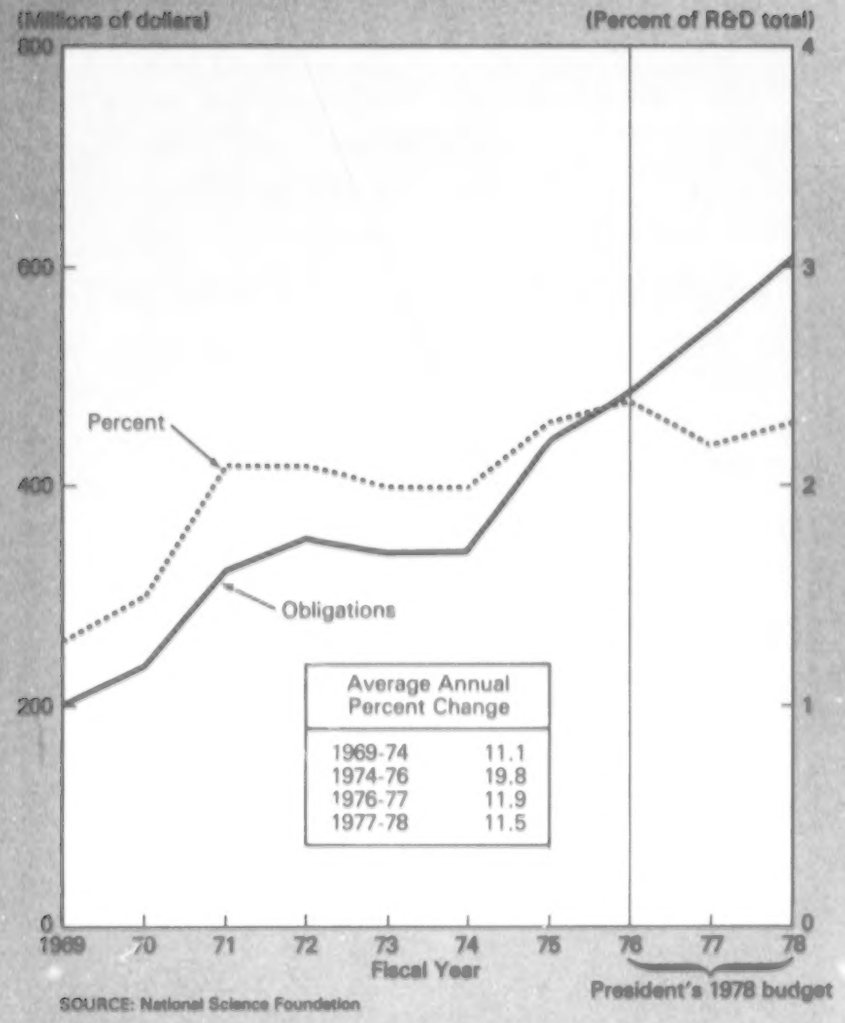
- The **multimodal** subfunction is entirely represented by one program, that of the Office of the Secretary of Transportation, DOT. This office provides support to the development of national transportation policies and programs. Areas of R&D activity include policy planning, university research, systems technology, safety, security, and consumer affairs.

- R&D funding under the **communications** subfunction was expected to increase 31 percent in the budget proposal, but the 1978 level would still be less than one-half of the peak level of 1972. In 1978 this subcategory accounts for 5 percent of the total transportation and communications effort compared with 14 percent in 1972.

  The NASA communications satellite program, which makes up three-quarters of this subfunction, was expected to increase 12 percent in 1978. NASA will institute a search and rescue satellite system demonstration as a cooperative venture with Canada. The agency will also carry out space communications experiments to be flown on space shuttle and spacelab missions, will make efforts to reallocate worldwide usage of radio frequencies, and undertake technology transfer activities in space telecommunications toward use by public and private industries.



NATURAL RESOURCES
FEDERAL R&D OBLIGATIONS



SOURCE: National Science Foundation

NATURAL RESOURCES

- The natural resources function continues to reflect important growth with increases of almost 12 percent shown for both 1977 and 1978 in the President's budget.

- This function grew at an average annual rate of 13.3 percent between 1969 and 1977, more than twice that of the Federal R&D total.

- Natural resources represented an estimated 2.2 percent share of the Federal R&D total in 1977 with 2.3 percent expected in 1978, compared with 1.3 percent in 1969.

Trends in R&D Programs

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Natural resources, total	$201.0	$488.8	$546.9	$609.8
	Percent distribution			
Mineral	20.9%	37.1%	36.3%	31.8%
Geologic and mineral resources surveys (GSG) (Interior)	9.8	14.5	14.3	13.2
Mining research (Bu. Mines) (Interior)	3.7	12.9	13.2	11.3
Metallurgy research (Bu. Mines) (Interior)	5.6	5.1	4.6	4.2
Other	1.8	4.6	4.2	3.0
Water	32.3	13.2	12.9	12.9
Water resources investigations (GS) (Interior)	5.7	4.1	4.1	4.0
Saline water R&D (OWRT) (Interior)	11.0	3.9	3.6	3.5
Water resources research (OWRT) (Interior)	5.3			
Water-related programs (Civil functions) (DOD)	4.6	1.9	1.9	2.6
Bureau of Reclamation (Interior)	3.6	1.7	1.9	1.5
Watershed management research (FS) (USDA)	1.9	1.6	1.5	1.4
Other	.2	–	–	–
Land	12.1	12.2	12.7	12.2
Forest insect and disease research (FS) (USDA)	3.1	3.7	3.6	3.3
Timber management research (FS) (USDA)	4.5	3.3	3.1	2.7
Forest resource evaluation (FS) (USDA)	1.2	1.1	1.7	2.2
Land information and analysis (GS) (Interior)	.5	1.7	1.8	1.7
Cooperative forestry research (CSRS) (USDA)	1.7	1.5	1.5	1.3
Other	1.0	.9	1.0	1.1
Recreation	12.7	7.0	7.2	7.4
National Park Service (Interior)	1.3	1.9	1.8	1.9
Wildlife resources (FWS) (Interior)	5.7	1.7	1.7	1.7
Fishery resources (FWS) (Interior)		1.1	1.2	1.2
Habitat preservation (FWS) (Interior		.9	.9	1.0
Wildlife, range, and fish habitat research (FS) (USDA)	1.4	1.0	1.2	1.1
Other	4.4	.4	.4	.4
Multiresource	22.0	30.4	30.9	35.7
Earth resources detection and monitoring (NASA)	9.5	17.6	16.8	21.8
Research on use and improvement of soil, water, and air (ARS) (USDA)	10.1	5.9	6.1	6.2
Applications explorer missions (NASA)	–	1.7	2.4	3.0
Sea Grant program (NOAA) (Commerce)	2.0	3.1	3.3	2.9
Other	.4	2.0	2.2	1.8

[1] Estimates based on President's 1978 budget to Congress.

SOURCE: National Science Foundation

Comments

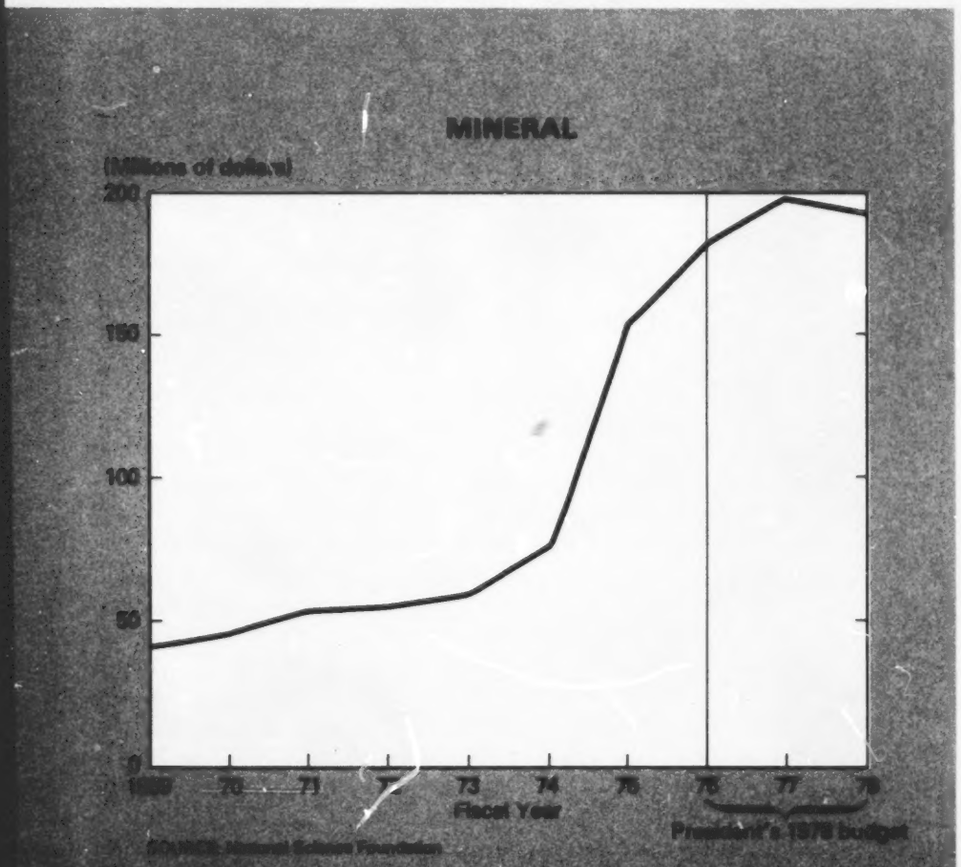
- In 1978 the **mineral** subfunction, which represents approximately one-third of total natural resources support, showed a decline in the President's budget. As a result of congressional action, however, it is now scheduled to grow in 1978.

  The largest program, geologic and mineral resources surveys, is sponsored by the Geological Survey (GS) in Interior. The overall increase in 1978 is brought about by growth in wilderness mineral surveys and Federal coal-leasing explorations. GS activities will continue toward accurate appraisal of national mineral resources, improvement of mineral exploration and extraction technology and techniques, and the establishment of basic geological data.

  The mining research program of the Bureau of Mines reflected a 5-percent reduction in the 1978 budget from the postponement of the underground mining methods demonstration and the reduction of subprograms in coal-mining technology. These activities were restored and increased by the Congress. Ongoing research projects are aimed at increased mining efficiency, including full consideration of health and environmental conditions, at moving marginal mineral deposits into production, and at advancing technology for coal extraction and preparation.

Another Bureau of Mines program is concerned with metallurgy research. In 1978 the funding level and program orientation will remain unchanged. R&D efforts seek to improve extracting, recovery, purification, fabrication, and recycling practices and to advance technology while minimizing cost, waste, and pollution.

Other programs include GS research on conservation of lands and minerals, Bureau of Mines demonstrations related to mined land (increased by the Congress) as well as other Bureau of Mines mineral resources programs, and work supported by NSF on seabed assessment and advanced processing technology.



- Although funding for the **water** subfunction was proposed for an increase of 11 percent in 1978, the average annual rate of growth for this subfunction was only 1.1 percent in the 1969-77 period. Programs sponsored by the Corps of Engineers (DOD) would account for most of the 1978 increase. The water share is approximately one-eighth of the natural resources total in the current (1976-78) period, compared with one-third in 1969.

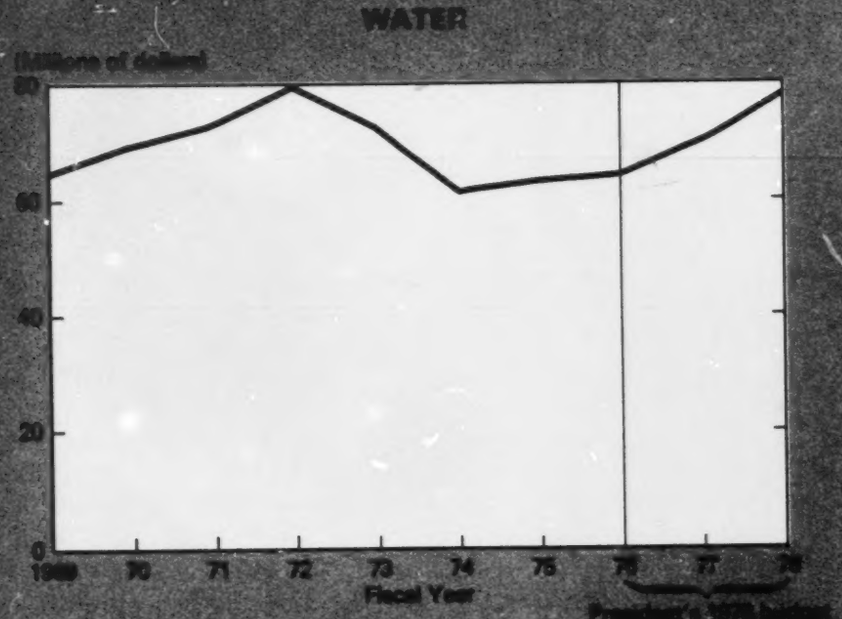
  The proposed rise of 8 percent in 1978 for GS water resources investigations would continue the steady funding increases that have occurred in this program since 1969. These investigations are concerned with the quality and quantity of water supply, the geographic and temporal patterns of availability, and the magnitude and pattern of water use. Research is directed to factors affecting stream flow, sedimentation, and subsurface waste and storage, and to establishment of timely water data as a basis for national water use, development, and planning.

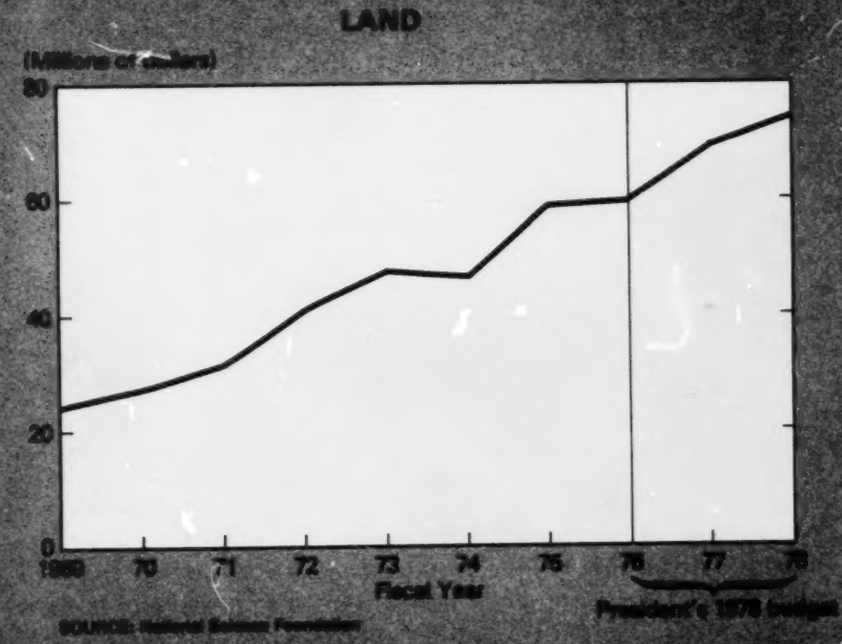
  The water resources research program conducted by the Office of Water Research and Technology (OWRT) in Interior was expected to increase 8 percent in 1978, although the level of funding would be considerably below 1969. Under this program assistance is given to States to support work at university-based water resources research institutes. Another part of the program supports research on water conservation and planning, and promotes development of technology for saline water conversion and water reuse.

  The Corps of Engineers (Civil Functions) within DOD conducts five R&D programs to improve national waterways. These programs cover flood control and navigation, coastal engineering, materials research, water resources planning, and streambank erosion control. An increase of more than 50 percent was planned in the budget for the funding of these programs in 1978.

  The Bureau of Reclamation (Interior) is working to develop a comprehensive system of managing atmospheric water resources and to improve water resources planning and water-related engineering. A smaller project involves research on geothermal and pumped storage systems, including the use of these types of water resources for energy production.

  The USDA Forest Service (FS) watershed management research program is devoted to problems of soil and water pollution, methods of increasing streamflow, and techniques of stabilizing soil.





SOURCE: National Science Foundation

- The 8-percent increase in support proposed for the **land** subfunction placed the 1978 funding level at more than three times that of 1969. The steady expansion of three R&D programs within the USDA Forest Service has accounted for most of this long-term growth.

  The largest program, forest insect and disease research, is a three-part effort to support insect control and management actions. No significant change in level of support was planned in 1978. The program defines, measures, and evaluates the ecological and socioeconomic impacts of insects on forests; detects, assesses, and predicts changes in insect occurrence; and reduces or maintains insect numbers and impacts at tolerable levels.

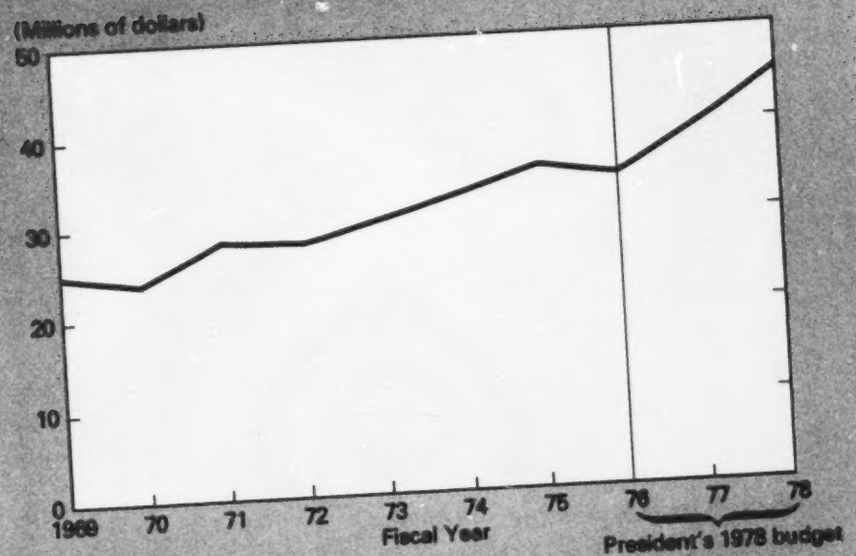
  The second program, timber management research, also shows no increase in 1978. This research is concerned with genetic improvement of trees, methods of intensive cultivation, and soil improvement.

  The third FS program, forest resource evaluation, has grown rapidly in recent years, including a 40-percent increase proposed in 1978. The forest survey conducted under this program provides national statistics on the quantity and quality of timber and indicates development opportunities for forest-based industries. The 1978 increase was to strengthen the ongoing survey and to support resource evaluations.

  The Geological Survey land information and analysis program showed a rise in 1978 in the budget request. This program works to upgrade land-use decisionmaking by improving the collection, processing, and distribution of land-resources and land-use data, and by developing geographic technology.

  The USDA Cooperative State Research Service (CSRS) sponsors a cooperative forestry research program under the land subfunction. With a requested 1978 funding level that is unchanged from 1977, this program will continue to support forestry research on production, management, insects, marketing, and other forest resource areas.

RECREATION



SOURCE: National Science Foundation

- Funding for the **recreation** subfunction was expected to increase 15 percent in the 1978 budget, the largest increase for this subfunction in the 1969-78 period.

The largest program, which is conducted by the National Park Service (Interior), was proposed for 19-percent growth in 1978. This program covers archeological research projects and natural resources planning, and resource management activities. The 1978 increase arose from the proposed expansion of R&D support for the operation of the national park system and for archeological investigations.

The Fish and Wildlife Service (FWS) has three programs that make up another important component of recreation R&D support. Together, these programs were expected to grow 13 percent in 1978 under the President's budget. The wildlife resources program, the largest of the three, supports research and study projects related to bird and mammal management.

The FWS fisheries resources program consists of research and study projects to promote the proliferation of sport fish in the natural environment. The program covers coastal, Great Lakes, and inland reservoir areas.

FWS habitat preservation research and study projects are directed toward improving the quality and availability of fish and wildlife habitat. They include environmental pollution evaluation, land and water resources planning, and biological services development.

The wildlife, range and fish habitat research program of the Forest Service addresses the quality of the terrestrial environment in terms of wildlife and livestock and their use by man. Program objectives are to maintain and increase the diversity and productivity of fish, wildlife, and domestic stock through habitat improvement.

- The **multiresource** subfunction was expected to increase 29 percent in the 1978 budget, which would make this subfunction the largest within natural resources. The main impetus for growth comes from the NASA Earth resources detection and monitoring program.

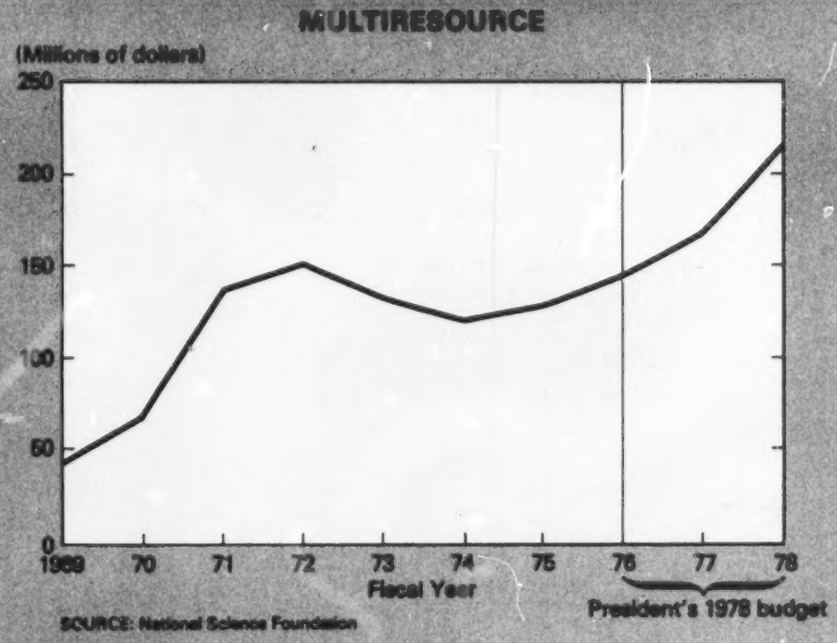
  The Earth resources detection and monitoring program is scheduled for a 45-percent rise in 1978 and will account for more than one-fifth of overall natural resources funding. Continuing demonstrations under this program are the Large Area Crop Inventory experiment to evaluate use of Landsat data in making estimates of global grain production, and other experiments in water resources management, eastern surface mine monitoring, land management, and environmental quality. Projected increases for 1978 will be for development of the Landsat-D, a next generation Earth resources satellite containing as a payload the thematic mapper, an advanced multispectral sensor.

  ARS research on use and improvement of soil, water, and air showed an increase of 13 percent in the 1978 budget. Activities of this program include improvement of soil and water management, strip mine reclamation, salinity control, fertilizer efficiency, tillage and irrigation practices, and understanding of the relation of soil types to plant, animal, and human nutrition.

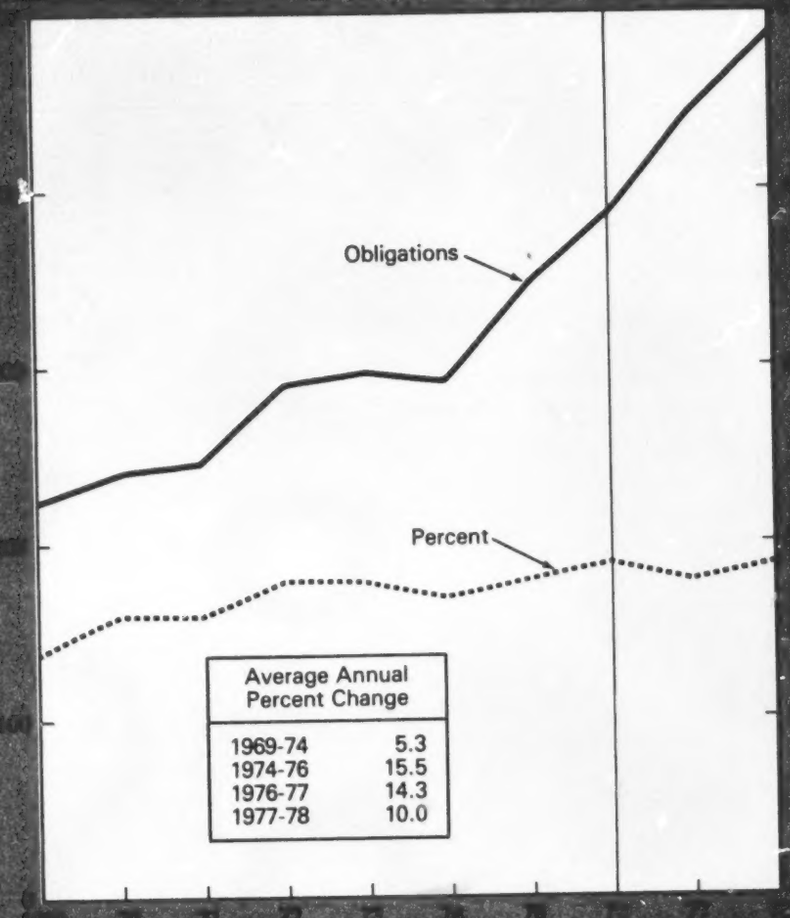
  The NASA applications explorer mission is scheduled for a 37-percent increase in 1978. This program covers development of the magnetic field satellite (Magsat), which is expected to provide data for updating maps of the Earth's magnetic field and for locating natural resources such as coal, oil, and minerals.

  In the 1978 budget the NOAA sea grants program would remain at the 1977 level of funding. Through matching grants to universities, institutes, and industries, this program aims to solve problems in management and use of marine resources and in technology transfer.

  Other programs within the multiresource subfunction include NSF programs concerned with living resources, resource systems, and resource conservation, and GS topographic surveys and mapping.



FOOD, FIBER, AND OTHER AGRICULTURAL PRODUCTS



- The food, fiber, and other agricultural products function has almost doubled in support in the 1969-77 period, but greatest growth has taken place since 1974. The average annual increase from 1974 to 1977 was 15.0 percent, and an increase of 10.0 percent was proposed for 1978 in the President's budget.

- Recent increases made the average annual growth rate of this function 8.9 percent between 1969 and 1977, one and one-half times the growth rate for all Federal R&D obligations.

- The share of food, fiber, and other agricultural products in the Federal R&D total was 1.8 percent in 1977 and an estimated 1.9 percent in 1978, compared with 1.4 percent in 1969.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Food, fiber, and other agricultural products, total	$225.0	$388.3	$444.0	$488.3
	Percent distribution			
Production	76.2%	79.8%	81.2%	81.4%
Research on plant production (ARS) (USDA)	33.1	22.6	22.9	24.1
Research on animal production (ARS) (USDA)		12.1	12.1	12.1
Food and nutrition research (ARS) (USDA)		2.3	3.0	3.0
Agricultural research under the Hatch Act (CSRS) (USDA)	22.9	21.9	22.4	22.0
Ocean fisheries and living marine resources (NOAA) (Commerce)	14.2	11.9	11.7	11.7
Agricultural research under the Morrill Act (CSRS) (USDA)	1.5	5.0	4.4	3.9
Fertilizer development (TVA)	1.9	1.8	2.1	2.1
Other	2.6	2.2	2.7	2.4
Marketing and distribution	23.3	19.7	18.3	18.1
Marketing efficiency (ARS) (USDA)	17.1	12.5	11.5	11.4
Expansion of agricultural exports (ARS) (USDA)		.5	.5	.5
Consumer services (ARS) (USDA)		.1	.1	.1
Economic Research Service (USDA)	5.9	6.2	5.9	5.8
Farmer Cooperative Service (USDA)	.4	.3	.3	3.1
Other	.4	.5	.5	.4

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

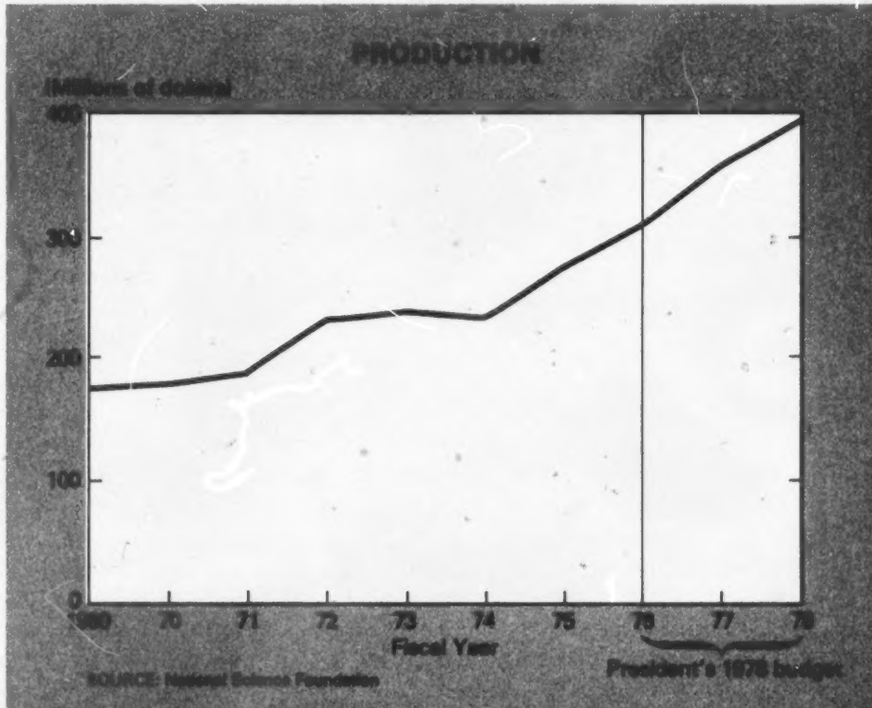
Comments

- **Production** is expected to account for more than four-fifths of the total R&D support for the food, fiber, and other agricultural products function in 1978. Funding for this subfunction has more than doubled between 1969 and 1977, increasing at an average annual rate of 9.7 percent. In 1978 the 10-percent proposed increase was the result of growth in almost all programs.

  Research on plant production of the USDA Agricultural Research Service (ARS) is the largest program within the food function, accounting for one-fourth of the total. It is expected to increase 16 percent in 1978. The emphasis is on research to improve genetic varieties, to increase yields, to improve production practices, to enhance environmental quality, and to improve crop protection technology. In recent years special emphasis has been placed on the photosynthetic process, the nitrogen-fixing process, and better use-efficiency of agricultural energy resources.

  Agricultural research supported by the USDA Cooperative Research Service (CSRS) under the Hatch Act accounts for more than one-fifth of the food function in 1978 and is scheduled for an 8-percent increase that year.[14] Under this program grants are provided for research at agricultural experiment stations of land-grant colleges throughout the United States.

[14] The Cooperative State Research Service respondents were unable to disaggregate this program into subcategories of activity, as the Agricultural Research Service respondents were able to do. If the six ARS programs shown in the table are added together, the total for ARS is far greater than that for CSRS.



ARS research on animal production is scheduled to increase 10 percent in 1978. Efforts are directed to improved production of high-quality livestock through better breeding, feeding, and management practices and toward better techniques for controlling animal diseases, parasites, insects, and other hazards.

The NOAA ocean fisheries and living marine resources program is also expected to increase 10 percent in 1978. This program concentrates on improving the management of living marine resources to ensure safe fishery products; on the conservation of endangered species; and on the continued existence of viable commercial and sports fishing industries.

Agricultural research, also conducted by CSRS under the Morrill Act, is expected to decline slightly in 1978. Contracts and grants cover a wide range of agricultural research at agricultural experiment stations and selected land-grant colleges. Research areas include grains, pasture and range, genetic vulnerability, pest management, and pesticide use.

ARS food and nutrition research shows an estimated 11-percent increase in 1978. This program generates information on human nutritional requirements and the composition of foods for Federal, State, and local agencies administering food and nutrition programs, and for general consumers.

The TVA fertilizer development program was proposed for increase of 9 percent in 1978. This program includes research and development on chemical fertilizers and development and demonstration of innovative processes to assist industry in lowering fertilizer production costs.

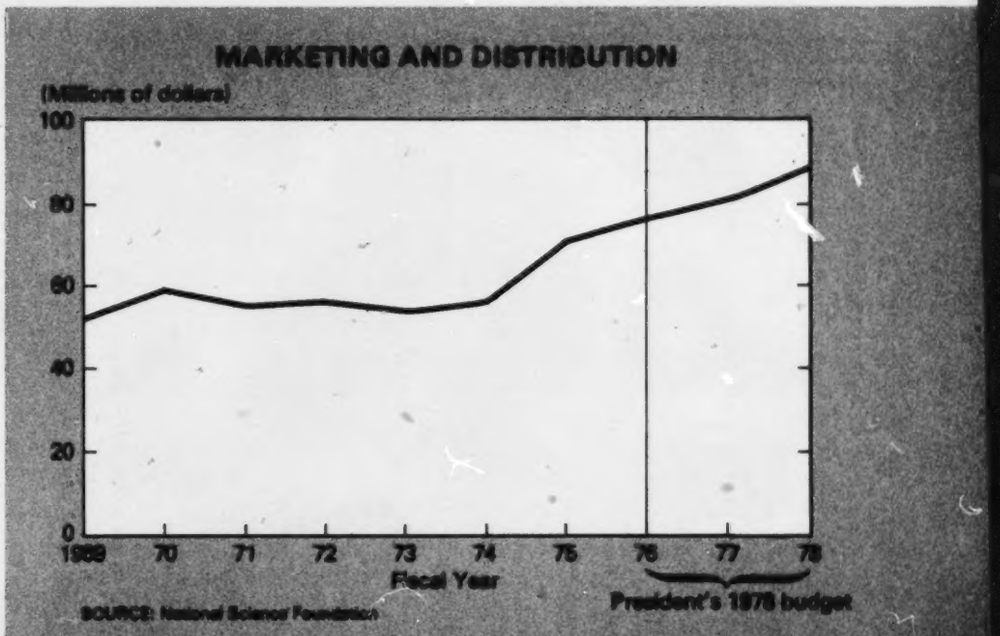
- The **marketing and distribution** subfunction reflected a 9-percent increase in the 1978 budget. Two USDA programs account for 95 percent of the funding.

  An increase of 9 percent is expected in the ARS marketing efficiency program. R&D activities are aimed at improving processing, storage, and distribution of agricultural products, developing new agricultural products and processes, and utilizing renewable agricultural commodities.

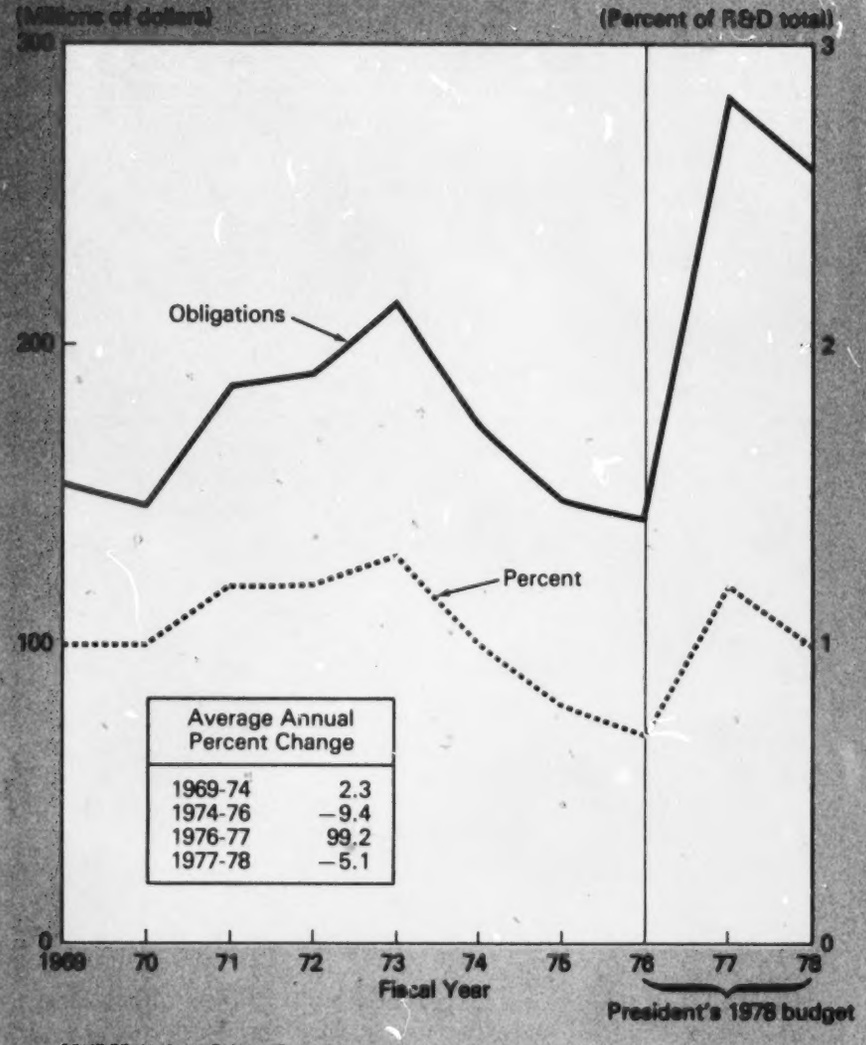
The Economic Research Service (ERS) program shows an 8-percent gain in 1978, continuing the steady growth that has since 1969 more than doubled this R&D effort. Analyses are conducted of production and marketing of farm commodities, national and macroeconomic effects, foreign demand and trade in agricultural commodities, national resource use and conservation, and domestic and foreign economic development.

The remaining programs, all sponsored by USDA, include two ARS programs—expansion of agricultural exports and consumer services—and the research program of the Farmer Cooperative Service.

- **Other** R&D programs within food, fiber, and other agricultural products are sponsored by the USDA Statistical Reporting Service and the National Agricultural Library (USDA).



EDUCATION
FEDERAL R&D OBLIGATIONS



SOURCE: National Science Foundation

111

EDUCATION

- Funding for education R&D programs has fluctuated appreciably during the 1969-78 period—increasing from 1969 to 1973 then decreasing between 1973 and 1976. Support doubled in 1977 but was expected to decline 5 percent in the 1978 budget request.

- Despite recent gains, the education share of the Federal R&D total was only 1.2 percent in 1977, and an estimated 1.0 percent in 1978, the same share as in 1969.

- The average annual growth rate for education R&D programs between 1969 and 1977 was 7.9 percent.

112

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Education, total	$154.8	$142.4	$283.8	$269.2
	Percent distribution			
Occupational, Vocational, and Adult Education (OE) (HEW)	–	24.6%	54.4%	47.5%
National Institute of Education (HEW)	54.3%	44.7	30.2	38.6
Education for the handicapped (OE) (HEW)	10.0	11.4	3.9	4.1
Special projects (OE) (HEW)	–	3.9	2.8	3.6
Science education development and research (NSF)	7.8	8.1	4.3	3.4
Head Start (OHD) (HEW)	2.8	3.5	1.8	1.9
Institutional science development (NSF)	15.7	–	–	–
Other	9.3	3.8	2.6	1.0

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

Comments

- In 1977 funding increased sharply for the occupational, vocational, and adult education program of the HEW Office of Education (OE), making it the largest component of the education function. In 1978 the program will account for approximately one-half of the function total. The primary purpose of this program is to provide grants for vocational R&D activities to be performed under the direction of State departments of education. In 1977 a changeover was effected to a new system of advanced funding to the States, which were to receive Federal monies a year ahead of their use by State school bodies. This change produced almost a doubled appropriation for 1977, and a decline in 1978, both for this program and for the education function. Later congressional action had the effect of reducing this program and changing the 1977-78 levels.

Another major component of the education function consists of the R&D programs of the HEW National Institute of Education (NIE). These programs had registered a 21-percent increase in the 1978 budget request, so that they accounted for almost two-fifths of the education total. Subsequent congressional action significantly reduced this increase.

The entire budget of NIE is devoted to R&D or R&D dissemination activities, and 90 percent of the funds are used for contracts and grants to extramural performers. Current programs are designed to improve basic skills in reading and mathematics, to clarify the relationship of education to work and careers, to improve the productivity of educational resources, and to help State and local education systems.

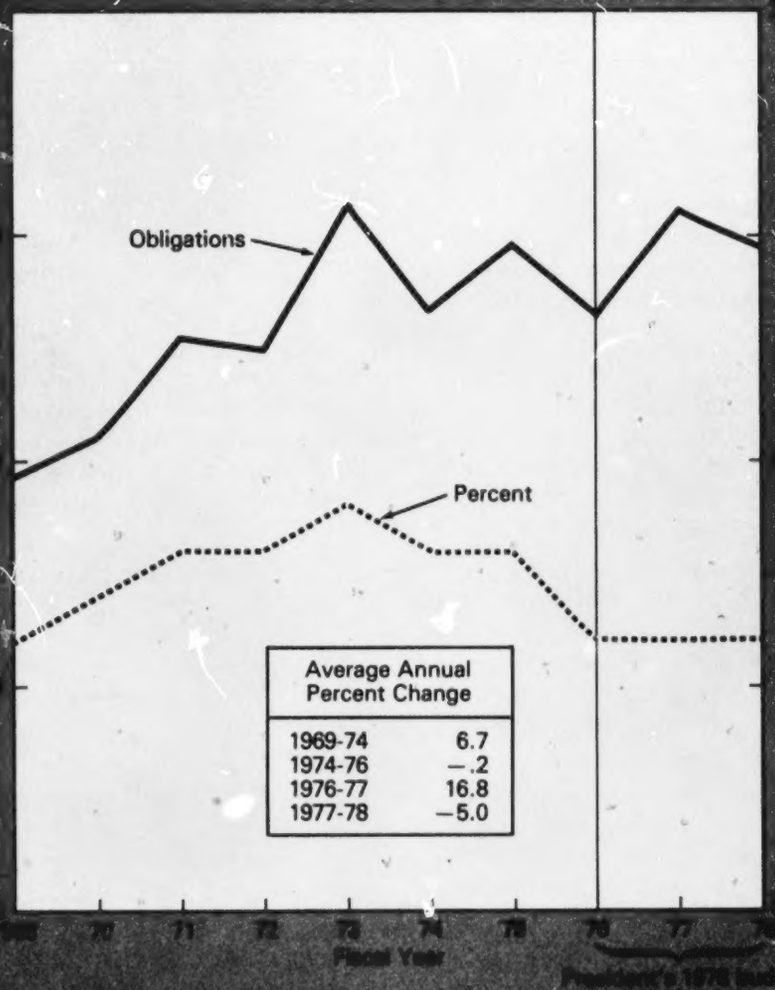
The OE education for the handicapped program now shows an increase in funding in 1978. Innovation in and development of curriculum and teaching techniques, and such projects as physical education and recreational research for handicapped children continue to be the chief emphases of this program.

The OE special projects program, scheduled for a 22-percent increase in 1978, includes as the major component curriculum development and demonstration to provide educational equity for women.

Funding for the NSF science education development and research program was set to decrease 25 percent in the 1978 budget, placing this program at one-fourth the peak level of 1974. Congressional action did not change this situation markedly. Program objectives are to advance science education through research in such areas as student choice of and success in science careers, and through aid in the development of better techniques, methods, and instructional materials for all educational levels.

Head Start research and experimentation shows no change in funding in 1978 nor does the support for three education policy research centers on the part of the HEW Office of the Assistant Secretary for Education.

INCOME SECURITY AND SOCIAL SERVICES



- In 1978 a proposed 5-percent decline in the total of R&D programs making up the income security and social services function would place support at approximately the 1975 level and 6 percent below the 1973 peak.

- The share of the income security and social services function within total Federal R&D support has remained at six-tenths of 1 percent since 1976. The highest share was nine-tenths of 1 percent in 1973.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Income security and social services, total	$ 96.7	$133.4	$155.9	$148.0
	Percent distribution			
Rehabilitation services and facilities (OHD) (HEW)	29.1%	16.3%	19.5%	20.7%
Social Security Administration (HEW)	7.6	10.8	12.9	15.4
Social services programs (OS) (HEW)	16.3	17.8	12.8	15.1
Employment and training administration (Labor)	21.7	13.2	12.3	11.7
Child development research and demonstration (OHD) (HEW)	3.7	11.5	9.9	10.5
Child abuse (OHD) (HEW)	—	9.5	7.4	7.8
Public assistance research and evaluation (SRS) (HEW)	12.9	5.5	5.9	6.2
Other	8.7	15.5	19.3	12.6

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

Comments

- The rehabilitation services and facilities program of the HEW Office of Human Development (OHD) is the largest program within the income security and social services function, accounting for one-fifth of the funding total in 1977 and 1978. This program supports research for the development of methods, services, procedures, and devices to assist in the provision of vocational rehabilitation services to handicapped individuals. The primary emphasis of the rehabilitation research program in 1978 is to relate activities more directly to State needs. Support for this program increased 40 percent in 1977, and a small increase is scheduled for 1978.

The second largest R&D effort consists of programs of the HEW Social Security Administration (SSA). These programs are scheduled to increase by 13 percent in 1978 and will make up 15 percent of the R&D total for this function. They cover research to improve the social security system as well as general studies on income security and health insurance.

The social services programs sponsored by the Office of the Secretary, HEW show a considerable increase in 1978 with the Congress adding to the increase requested in the budget. These programs cover income maintenance investigations (expanded further by the Congress), health insurance experiments, studies of long-term care, State and local services research, and basic research conducted by the Institute for Research on Poverty.

R&D funding by the Employment and Training Administration (Labor) was expected to drop 10 percent in the 1978 budget, after having risen in 1976 and 1977 for the first time since 1969. Efforts are focused on increasing employment and raising the skill level of the work force while minimizing inflation and other adverse economic effects.

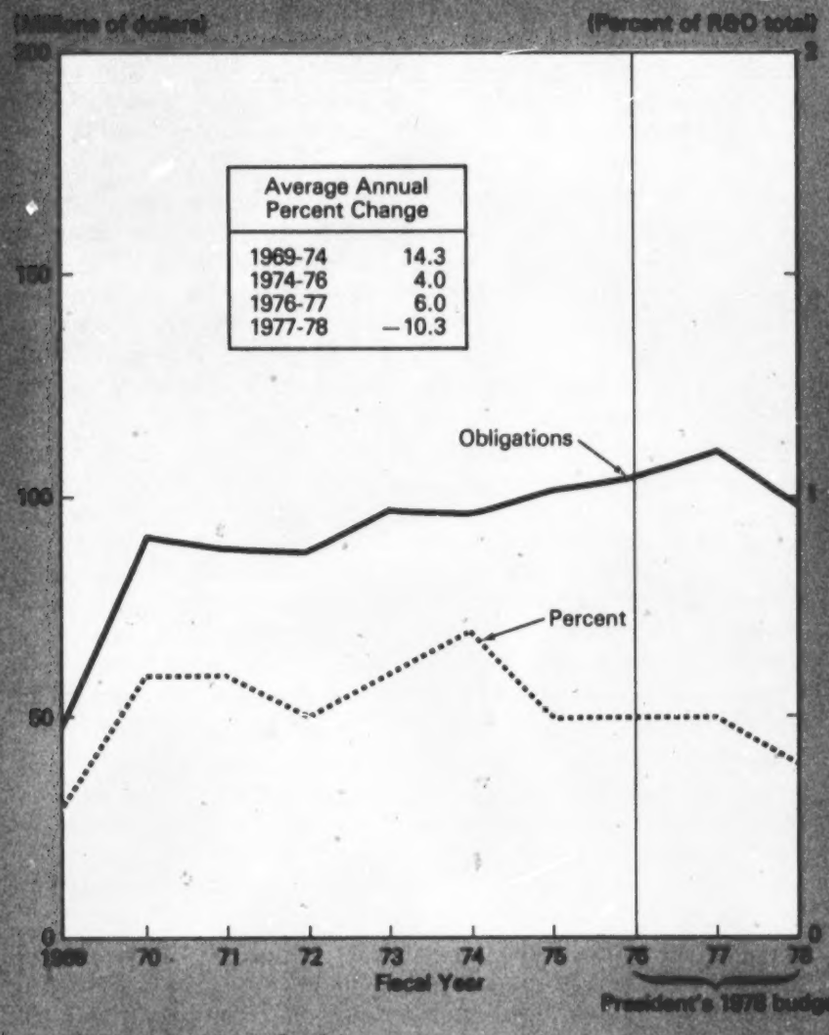
In 1978 the OHD child development research and demonstration program is scheduled for funding at about the same level as 1976 and 1977. This program supports R&D activities in child development, child welfare, and delivery of services to children and families. Special areas of concern in 1978 will include day care, child development and family life, and children with special needs.

The child abuse program of OHD was begun in 1975 and has received almost the same amount of funding each year since then. Activities include demonstration of methods for preventing, identifying, and treating child abuse and neglect. They also include studies to provide information on the national incidence and severity of child abuse and neglect and on the characteristics of the parents responsible.

The public assistance research and evaluation efforts of HEW's Social and Rehabilitation Services (SRS) are expected to remain at the 1977 funding level. Grants and contracts are awarded to develop and evaluate principles and concepts for use in public assistance programs and to demonstrate new systems for delivery of services to the disadvantaged.

The 1978 decline in total support for income security and social services resulted primarily from the exclusion of funds for the research and demonstration projects of the Community Services Administration. These projects test mechanisms for delivering social services to the poor. Later, Congress provided funds for this program to be continued.

Other programs found within the income security and social services function are OHD programs for aging and youth, programs of the Employment Standards Administration (Labor) and programs of the Civil Service Commission.



SOURCE: National Science Foundation

AREA AND COMMUNITY DEVELOPMENT, HOUSING, AND PUBLIC SERVICES

- After a large increase in 1970, the area and community development, housing, and public services function has shown only sporadic changes in the level of R&D funding. The 10-percent drop proposed for 1978 would place support for this function only 9 percent above the level of 1970.

- The share of this function in the Federal R&D total has always been less than 1 percent. In 1977 it was five-tenths of 1 percent and in 1978 it was expected to be four-tenths of 1 percent.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Area and community development, housing, and public services, total	$ 49.4	$104.2	$110.5	$ 99.2
	Percent distribution			
Department of Housing and Urban Development	42.6%	64.8%	56.7%	68.2%
Housing assistance research	([2])	17.4	12.3	14.1
Housing economic data and analyses	([2])	10.0	9.8	12.1
Community conservation research	([2])	6.1	7.3	8.4
Community development research	([2])	8.6	5.4	7.3
Consumer and equal opportunity research	([2])	3.9	4.2	5.1
Housing safety and standards research	([2])	6.1	4.5	4.9
Energy conservation and standards research	([2])	4.0	3.5	4.1
Program evaluation	([2])	1.3	1.7	2.5
Research program support and utilization	([2])	1.5	1.4	1.9
Administrative expenses	([2])	6.0	6.6	7.7
Public services and intergovernmental programs (RANN) (NSF)	.3	9.7	11.3	10.7
Community development (CSA)	44.6	4.8	12.7	8.8
Economic Development Administration (Commerce)	10.7	14.5	13.2	4.5
Other	1.8	6.2	6.2	7.8

[1] Estimates based on the President's 1978 budget to Congress.

[2] Detail not available prior to 1976.

SOURCE: National Science Foundation

Comments

- The Department of Housing and Urban Development (HUD) has provided most of the support for R&D programs under this function since 1970. An increase of 8 percent for 1978 was requested for HUD R&D programs in the President's budget. Subsequent congressional action, however, resulted in a decline.

The largest of the HUD programs is the housing assistance research program, which represents more than one-fifth of the HUD total in 1978. This program concentrates on testing and analyzing the concept of direct-cash assistance housing allowances.

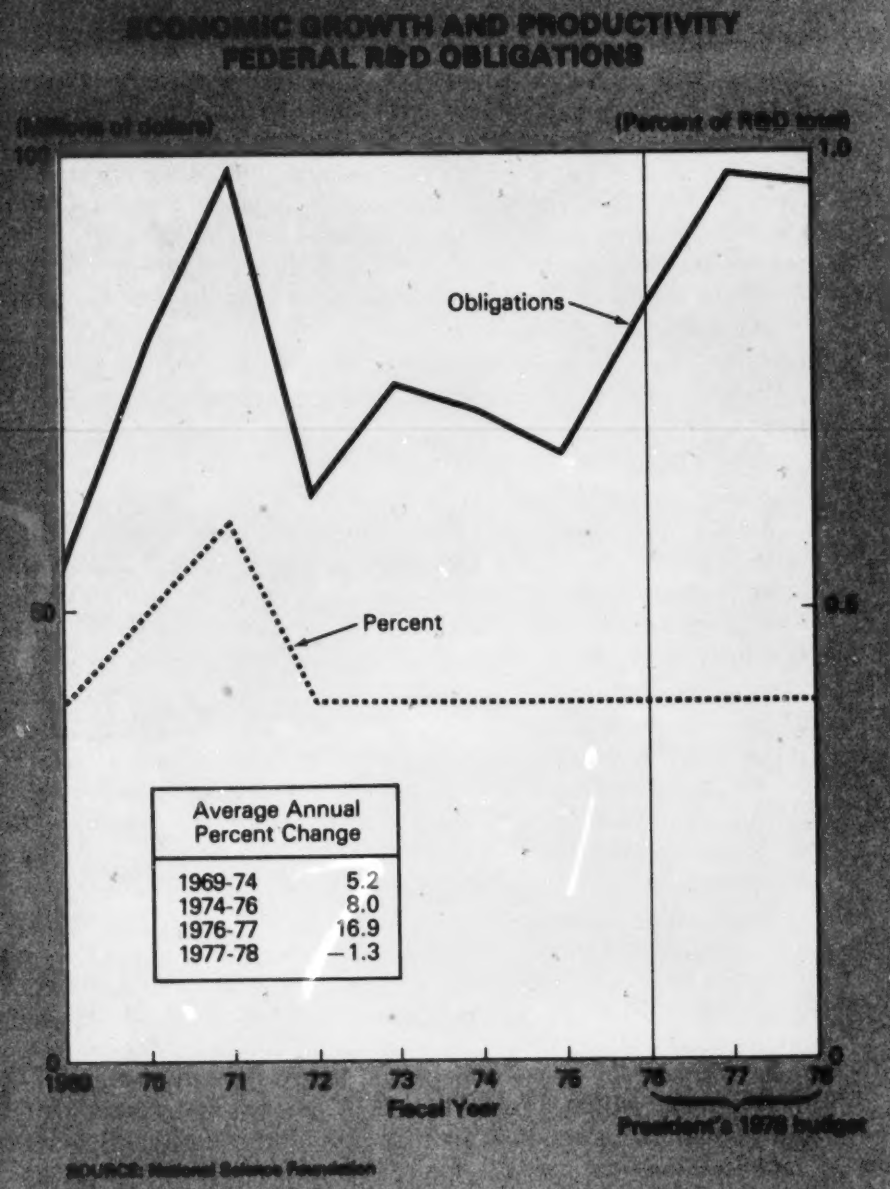
Another HUD program, housing economic data and analyses, generates information about the quality and supply of the Nation's housing stock, housing and mortgage trends, and demographic changes that relate to housing and urban problems. *The Annual Housing Survey* is the largest single project within this program.

Other HUD programs include community conservation research to assist cities in preserving and revitalizing neighborhoods; community development research to help State and local government units improve their policy analysis, service delivery, and financial management capabilities; consumer and equal opportunity research to reduce discriminatory housing practices; housing safety and standards research; and energy conservation and standards research.

Three NSF public service and intergovernmental programs within the broader RANN program account for more than one-tenth of the R&D activity in this function. The public service programs focus on the major determinants of public sector productivity and attempt to improve local government productivity by providing information on techniques and operating methods. The intergovernmental program encourages the integration of science and technology planning with State and local government policymaking. Support for these NSF programs has remained at nearly the same level since 1973.

The community development program of the Community Services Administration (CSA) is directed toward economic development in rural and urban areas that contain concentrations of low-income persons. Reduced funding was expected in the 1978 budget proposal as more model community development corporations become operational or are terminated.

The R&D program of the Economic Development Administration (Commerce) consists of studies to identify problems hindering local growth as well as research on economic and geographic factors related to economic development. This program was expected to be cut by more than one-half in the 1978 budget.



123

ECONOMIC GROWTH AND PRODUCTIVITY

- The level of funding for economic growth and productivity has fluctuated throughout the 1969-78 period with peak years in 1971 and 1977. The average annual growth rate between 1969 and 1977 was 7.3 percent, but a decline of 1 percent was expected in the 1978 budget.

- This function has represented four-tenths of 1 percent of the Federal R&D total in almost every year and never as much as 1 percent even though it currently covers 24 programs.

124

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Economic growth and productivity, total	$55.8	$83.9	$98.1	$96.8
	Percent distribution			
Industry and productivity research (RANN) (NSF)	–	21.3%	19.3%	19.7%
Services to improve use of materials (NBS) (Commerce)	9.4%	19.0	18.5	18.0
Forest products utilization research (FS) (USDA)	12.6	12.4	12.0	12.2
Technology utilization (NASA)	7.9	12.4	11.9	12.1
Services to improve the application of technology (NBS) (Commerce)	7.8	8.4	8.2	6.9
Postal Service	34.9	–	–	–
Other	27.4	26.4	30.0	31.0

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

Comments

- Within the broad Research Applied to National Needs (RANN) program of NSF industry and productivity research is a heading that encompasses a group of research programs. Little change in funding for these programs was indicated in the 1978 budget request. They cover research on advanced industrial processing, the effects of regulation, the nature of regional productivity, the measurement of national productivity, public/private relationships, and the stimulation of industrial R&D efforts.

Services to improve the use of materials of the National Bureau of Standards (NBS) within Commerce is currently the largest single program under the economic growth and productivity function, accounting for 18 percent of the total in the 1978 budget. Reversing a general growth trend since 1969, this program is scheduled for a slight decrease in 1978 as several metallurgical and polymeric materials projects have been scheduled for elimination. Research continues, however, on the properties and performance of materials and on the development of reference materials calibration and measurement standards.

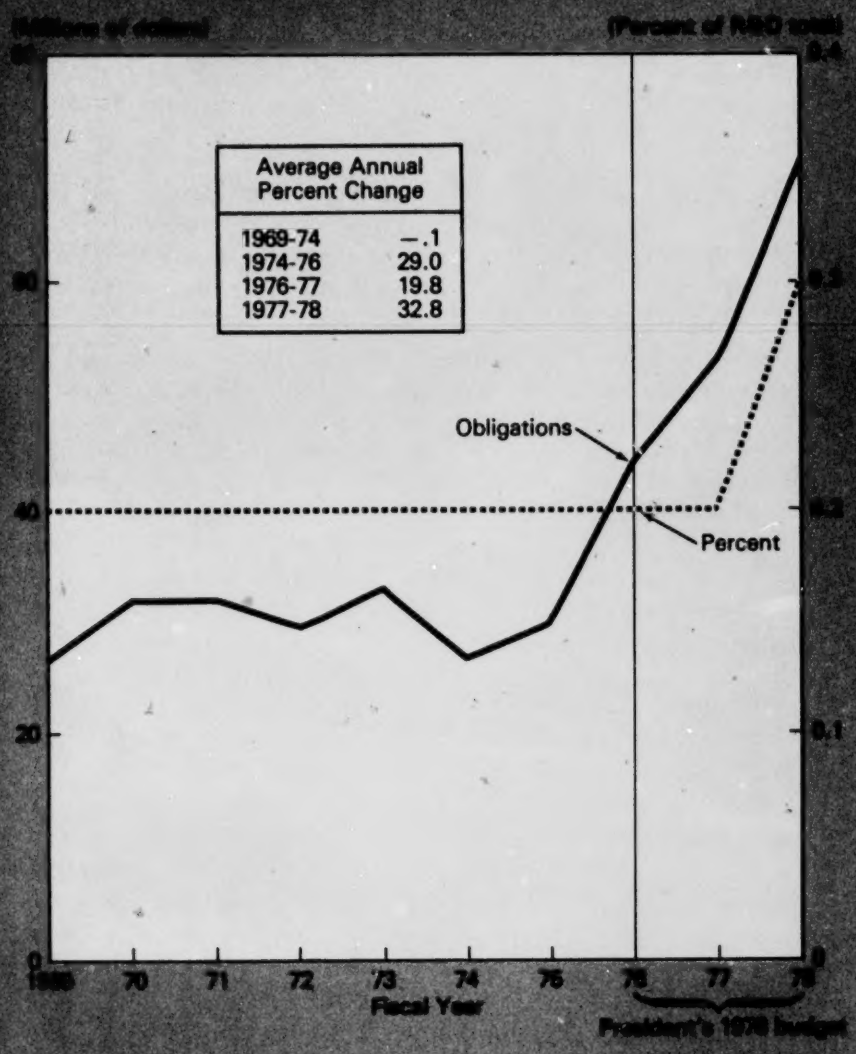
In USDA little change is now expected in the research program of the Forest Service (FS) on forest products utilization. Research is designed to develop technology for more efficient use of wood as well as to reduce costs, to extend timber supplies, and to reduce the pollution associated with wood utilization.

The NASA technology utilization program is concerned with the transfer of technological advances from NASA research and development into general private and public use. This program has undergone considerable expansion in recent years, but is not scheduled to grow in 1978.

Support for another NBS program—services to improve the application of technology—was expected to decline in the 1978 budget request as the building use analysis and construction standards projects are terminated. R&D activities were to continue on technological and engineering standards; measurements for products, commodities, devices, processes, or systems; and the utilization of new applications of technology.

Thirteen other programs are included in the economic growth and productivity function. Among them are the forest engineering and the forest economics and marketing research programs conducted by the Forest Service; the improvement of computer technology applications of NBS; the research on policy development of the Labor Management Services Administration (Labor); and building research performed by the General Services Administration. Research in economic areas is also conducted by the Federal Trade Commission, the U.S. International Trade Commission, and the Interstate Commerce Commission.

INTERNATIONAL COOPERATION AND DEVELOPMENT
FEDERAL R&D OBLIGATIONS



SOURCE: National Science Foundation

INTERNATIONAL COOPERATION AND DEVELOPMENT

- The international cooperation and development function showed little growth between 1969 and 1975. In the current (1976-78) reporting period this function reflects a large increase, due partly to reporting changes and partly to funding increases.

- The share of this function in the Federal R&D total was an estimated two-tenths of 1 percent from 1969 through 1977, compared with an estimated three-tenths in 1978.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
International cooperation and development, total	$26.8	$44.5	$53.3	$70.8
	Percent distribution			
Agency for International Development (State)	72.5%	84.8%	83.7%	85.2%
International cooperative scientific activities (NSF)	1.8	8.2	8.3	7.5
U.S. Arms Control and Disarmament Agency	22.4	3.2	4.4	3.6
Departmental funds (State)	.5	3.6	2.9	3.3
Other	2.8	.2	.6	.5

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

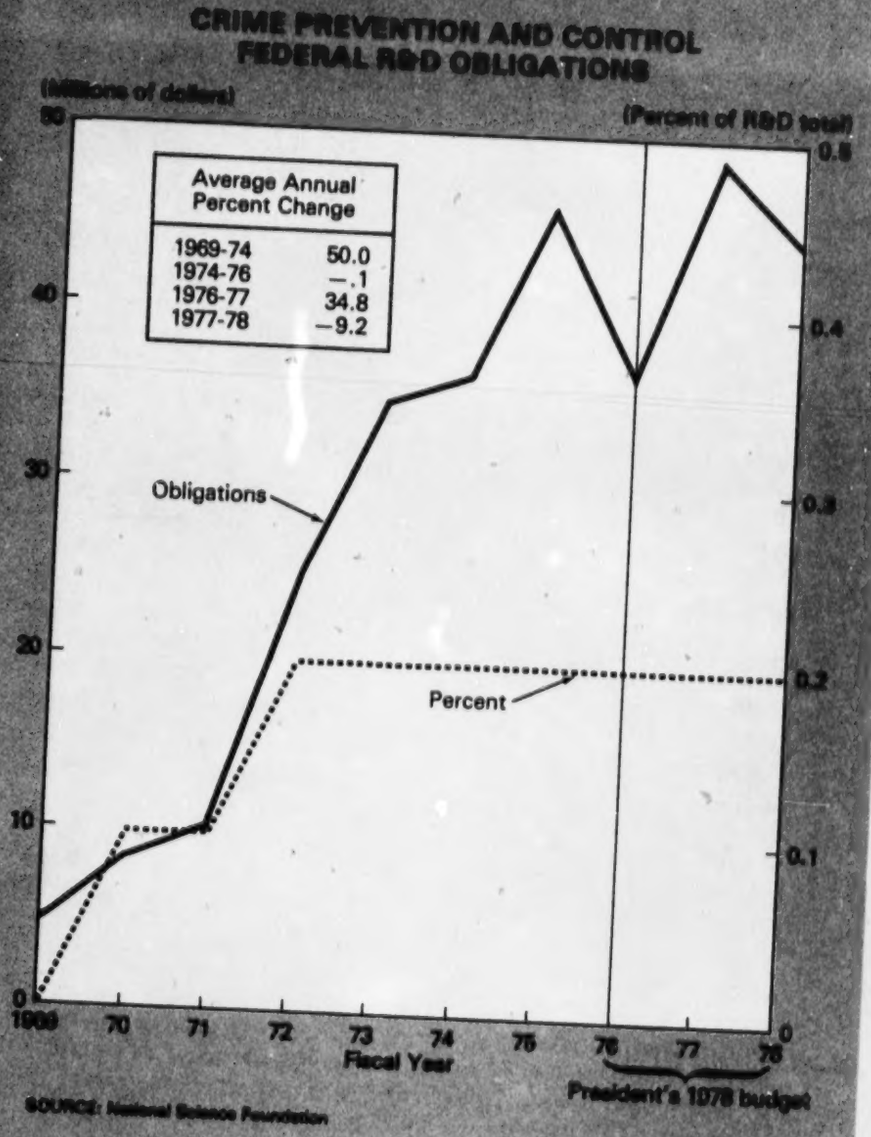
- The Agency for International Development (AID) of the Department of State is the major component of the international cooperation and development function. Since 1970 AID has contributed more than three-fourths of the funding for this function.

  The AID R&D program supports AID worldwide, regional and country programs by furnishing technical information and expert sources from other Federal agencies, universities, professional associations, and private research firms. AID efforts to help the poorest people in less developed countries are focused on agriculture and nutrition, health and family planning, science and technology, and economics and social sciences. Evaluation research is also conducted to determine program impact and to guide program changes. The total program was proposed for an increase of 35 percent in the 1978 budget.

  International cooperative scientific activities of NSF strengthen the scientific community by providing opportunities for significant interactions between U.S. scientists and their foreign counterparts. No program growth was anticipated in the 1978 budget planning.

  U.S. Arms Control and Disarmament Agency R&D obligations were expected to rise only slightly in 1978. Work is directed to support of the strategic arms limitations talks and negotiations on mutual and balanced force reduction. Efforts are addressed to finding means of limiting nuclear weapons testing, to development of techniques to prevent proliferation, and to other means of encouraging arms control initiatives.

  In 1978 the State Department planned in its request to increase its studies of long-range foreign relations policy issues and opportunities.



CRIME PREVENTION AND CONTROL

- The crime prevention and control function showed the highest growth rate among all Federal R&D functions from 1969 to 1975, having started from a small base. Between 1975 and 1977 some further growth occurred. In 1978, however, funding was expected to decline 9 percent, as shown in the budget request.

- The share of this function in the Federal R&D total has remained two-tenths of 1 percent in each year since 1974, and in earlier years it was even smaller.

	1969	1976	1977[1]	1978[1]
	[Dollars in millions]			
Crime prevention and control, total	$ 4.8	$36.3	$48.9	$44.4
	Percent distribution			
Law Enforcement Assistance Administration excluding narcotics control (Justice)	76.8%	77.7%	71.6%	66.5%
Drug Enforcement Administration (Justice)	12.6	6.9	13.3	7.4
Bureau of Alcohol, Tobacco, and Firearms (Treasury)	–	–	2.7	5.2
Bureau of Prisons (Justice)	5.1	2.1	2.7	4.6
Office of the Attorney General (Justice)	–	–	–	4.5
Federal Bureau of Investigation (Justice)	5.6	3.4	2.9	4.1
U.S. Customs Service (Treasury)	–	2.6	2.4	3.5
R&D on eradication of narcotic producing plants (ARS) (USDA)	–	4.0	2.9	3.2
Other	–	3.3	1.5	.9

[1] Estimates based on the President's 1978 budget to Congress.

SOURCE: National Science Foundation

Comments

- The largest R&D effort in the crime prevention and control function is represented by a group of programs supported by the Law Enforcement Assistance Administration (LEAA) in the Department of Justice. Although R&D funding by LEAA was expected to drop 16 percent in the 1978 budget, LEAA will still contribute two-thirds of the function total. The decline was reflected in equipment systems programs as well as in reduced funding for cooperative (State and local) research. LEAA will continue to support a wide range of R&D crime-related work: in juvenile delinquency, technology transfer, police effectiveness, court improvement, laboratory techniques, and evaluation research.

  The Drug Enforcement Agency (DEA) of the Department of Justice, after a sizable increase in 1977, was reduced by one-half in the 1978 budget request. The R&D activities of DEA include drug evaluation and methodology to improve the scientific criteria for classifying drugs for legal control as well as development of equipment, materials, and methods for use in drug law enforcement.

  In 1977 the Bureau of Alcohol, Tobacco, and Firearms in the Department of the Treasury initiated an R&D program of systems development relating to the addition of "taggants" to explosive materials as a means of detecting explosives used in bombs prior to detonation and of identifying sources of explosives after an explosion. The President's 1978 budget provided for significant expansion in this program.

APPENDIXES

A. Technical Notes
B. Detailed Statistical Table

Technical Notes

APPENDIX A

These notes deal with the scope and method of compiling this report and with its relationship to other reports and studies.

Scope

This report is based entirely on data reported to the National Science Foundation by Federal agencies in the form of actual obligation levels for R&D programs for fiscal years 1969 through 1976 and estimated obligation levels for R&D programs for fiscal years 1977 and 1978. All Federal agencies with R&D programs are covered. Individual programs are assigned by NSF staff to functional categories on the basis of the primary objective of the R&D activity rather than the primary objective of the overall agency mission. The purpose of the analysis is to make visible the main directions of Federal R&D efforts and to obtain a view of changes in priorities over a period of time.

The sources of data have been agency responses to the annual NSF survey, *Federal Funds for Research, Development, and Other Scientific Activities,* Volumes XIX through XXVI. The surveys began to provide data on program support levels in Volume XX when obligational data were reported by program for the first time, making possible the compilation of a report of this nature. Programs have been identified in each annual survey by the appropriation titles and activities under which they appear in the Federal budget. With this information and some additional program breaks obtained by interview, the function series could be constructed from 1970 through the latest year. Comparable program data for 1969 were informally obtained from the agencies.

Each new report in the function series is constructed on the basis of the agency/program structure existing at the time of the latest Federal budget. In the present report 1978 budget titles and agency program sponsorship are used, with the data for prior years arranged to conform to the present structure. The only exceptions are in the case of programs that have been terminated altogether but must still be shown as part of prior-year totals; these are listed in the program stub under the agencies that sponsored them at the time. In a number of instances the allocation of dollar amounts to earlier programs had to be estimated either because some agencies did not exist in earlier years or did not exist as identifiable units or because agency and program reorganizations have sometimes resulted in program splitting.

Timing

Data obtained from the current *Federal Funds* survey for fiscal years 1976-78 are based on program requests contained in the President's budget message to Congress in January 1977. By the time the *Federal Funds* questionnaire was completed in March-April 1977, however, some revisions had been made in budget program levels to reflect programming or other changes.

Data for 1977 and 1978 are estimated and do not reflect final apportionment actions and programming for 1977 or appropriation and apportionment actions for 1978 occurring after the President's budget request.

Organization

This report is organized in two major parts. Part I is concerned with broad comparisons of growth rates for the various functions throughout the 1969-78 period, and for shorter periods within that timespan, and with shifts in priorities between functional areas. Part II is concerned with a detailed analysis of each function, including a discussion of individual R&D programs under functions and subfunctions and changes in programs over time. Special attention is given to significant changes between 1977 and 1978.

Since 401 programs or program areas are covered in this report, descriptions were kept brief. The sources for program descriptions were (1) the narrative sections of the *Federal Funds* survey responses; (2) the *Budget Appendix, 1978;* (3) *Special Analysis P: Federal Research and Development Program* of the 1978 budget; and (4) congressional committee reports.

Method

Structure: The classification system in this report is based on 15 functions and 32 subfunctions that form the structure for the analysis. The categories were chosen to make visible the most important R&D objectives as reflected in agency programs in the 1978 Federal budget. Functions and subfunctions were chosen on the basis of size of effort, current and ongoing public interest in an area, and the need for a clearcut definitional framework encompassing all Federal R&D programs. No ambiguous function headings, such as "other" or "miscellaneous" were used.

The data are additive to 100 percent so that no overlap occurs between functions or programs, and programs are assigned to functions and subfunctions in terms of their primary R&D purposes. Such a system permits a comparison of priorities on an internally consistent and mutually exclusive basis.

Definitions: The definitions of R&D activities are those provided the agencies by NSF in its *Federal Funds* survey instructions.

The definitions of functions and subfunctions are implicit in their titles and content. Some programs, however, might appear to span more than one functional area with equal emphasis in each area. This situation has arisen in the case of some programs related to *natural resources* and *environment.* Thus, a rule was evolved that R&D programs primarily devoted to studying, inventorying, or managing resources would be placed under *natural resources* and that R&D programs primarily devoted to studying interactions within systems or studying pollution and/or its effects on living systems would be placed under *environment.* Safety programs were additionally placed under environment (under the *environmental health and safety* subfunction).

Also, in the case of programs that might fall between *area and community development, housing, and public services* and *income security and social services,* the criterion was established that programs primarily directed to improving the economies or general conditions of regions, including urban areas, were to be placed under the *area and community development* function and programs directed primarily to bettering the economic or social conditions of individuals were to be placed under *income security and social services.*

NSF staff decided on the assignment of the programs to given functions or subfunctions, and with all the Federal R&D programs studied and compared at one time, the staff could resolve fine points of difference and group like programs together.

Average annual growth rate comparisons: Tables showing average annual percent changes are based on growth rate conversion tables, which provide average annual growth rates for given timespans and given ratios of terminal-year data to initial-year data. Conversion tables are based on a standard compound interest rate formula.

Relation to Other Reports

(1) Since 1952 NSF has published an annual series covering Federal R&D funding by agencies. The reports are issued under the title *Federal funds for Research, Development, and Other Scientific Activities.* They include R&D expenditures and R&D obligations by agencies. The obligational data are further broken down by basic research, applied research, and development, as well as by performing group, field of science, and State distribution. As noted above, the agency program data furnished for *Federal Funds,* Volumes XX through XXVI, were used for this report to construct the series back to 1969. Overall totals in the historical tables for *Federal Funds,* Volume XXVI and in this report are identical.

(2) *An Analysis of Federal R&D Funding by Budget Function, Fiscal Years 1960-1972,* published in 1971, was the first NSF report to compile and analyze Federal R&D data on a functional basis. It was based for the most part on aggregate program totals of agencies and agency subdivisions, and did not probe deeper to the individual program level. It followed the function

system in the Federal budget, which is shown in terms of outlays only. For comparability, R&D data were shown in terms of expenditures. The R&D program distribution, which followed the budget function scheme established by the Office of Management and Budget (OMB), placed programs under function headings that embraced overall missions of the sponsoring agencies. While ratios could thus be obtained of the R&D effort to the total Federal effort in each function area, many R&D programs had to be placed under inappropriate categories.

(3) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1963-1973,* published in 1972, also followed the budget function system and provided R&D data in terms of expenditures. It again placed R&D programs under functions that embraced the overall missions of sponsoring agencies. In addition, however, this report offered an alternative system whereby R&D programs were arranged by a separate set of functions that reflected the primary purposes of the programs so that a truer perspective on R&D priorities could be obtained.

(4) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1974,* published in 1973, was based on a classification system that evolved from the alternative approach. This report did not follow the budget function structure, which is shown in outlays, and therefore data could be shown in obligations, which more closely reflect budget planning than do expenditures. A total of 14 function headings were used, with 40 subfunctions.

Even though function headings were similar in some cases to those used in the Federal budget (e.g., national security, space, and health), the criteria for assigning R&D programs to functions differed between the two systems. Hence, ratios of R&D programs to overall Federal programs in given functional areas could not be calculated. For example, in the budget system, under the *health* function the health-related R&D programs of the Veterans Administration (VA) are omitted because they are posted under a *veterans benefits* function, whereas in the system used in this report the R&D portion of VA programs related to health are included under *health.* In all other cases where a function heading was the same in concept in this report and previous reports, the differences in overall function structures meant that the R&D program content for a function would differ somewhat between reports.

(5) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1975,* published in 1974, and *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1976,* published in 1975, followed exactly the same function/subfunction structure as the 1969-1974 report. From one report to another, however, programs were sometimes shifted between functions as program purposes were reevaluated. Each report was, thus, a revised edition with changed historical series.

(6) *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1977,* differed from the previous reports in that the structure was based on 15 functions and 34 subfunctions. A new major function was added—*food, fiber, and other agricultural products.* The programs under this function consisted of those formerly assigned to a *food* subfunction within *natural resources,* plus five programs formerly placed under *economic growth and productivity.*

This report, 1969-1978, follows the same function/subfunction structure as in the 1969-1977 report except for the elimination of the two subfunctions under *crime prevention and control.*

(7) In *Special Analyses, Budget of the United States Government, Fiscal Year 1978, Special Analysis P: Federal Research and Development Programs,* OMB published estimates of obligations and expenditures for Federal research, development, and R&D plant. *Special Analysis P* cited higher totals for Federal energy R&D and R&D plant activities in 1977 and 1978 than are shown in this report: $2.9 billion and $3.9 billion, respectively, compared with $2.4 billion and $2.9 billion shown for the NSF *energy development and conversion* function. These differences arose primarily from the fact that R&D plant data are not included in this report and that the OMB figures are based on budget authority rather than obligations. In this report the energy totals for 1977 and 1978 would be $2.9 billion and $3.4 billion, respectively, if R&D plant data were included.

Other differences could arise from the fact that the *Special Analysis* total is not based on a function system additive to 100 percent, and the analysis therefore could include energy-related programs whose primary goals were environment- or natural-resource based, as well as R&D programs primarily devoted to energy. Because the function system in this report is additive to 100 percent and each R&D program was assigned to only one function or subfunction on the basis of the primary purpose of the program, the energy total is lower. For example, energy-related environmental R&D programs appear in this report under the environment function and are not included in the energy total.

(8) Other reports based on functional studies of the Federal budget have been published, some of them covering R&D data specifically. These have not followed the budget classification completely but have made certain rearrangements of data under functional headings, and retitled some of the headings. It should be stressed that every function system is judgmental and each system reflects the concerns of the times and the needs of the audience for whom it is devised.

APPENDIX B

Detailed Statistical Table

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Total, all functions	$15,641.1	$15,340.3	$15,545.0	$16,497.8	$16,800.1	$17,414.7	$19,013.3	$20,758.6	$24,465.3	$26,316.7
National defense, total	8,353.7	7,976.3	8,106.1	8,897.7	8,997.9	8,974.6	9,620.9	10,346.2	11,917.0	12,906.8
Defense military	7,687.0	7,350.9	7,500.5	8,307.1	8,394.1	8,409.0	9,001.0	9,629.1	11,147.2	12,080.7
DOD-RDT&E	7,386.9	6,984.4	7,161.4	7,945.3	8,000.4	8,008.5	8,571.9	9,212.4	10,707.4	11,657.4
Technology base	(1)	(1)	(1)	1,461.9	1,376.1	1,353.4	1,371.5	1,486.6	1,710.0	1,882.4
Advanced technology development	(1)	(1)	(1)	238.4	160.0	200.2	300.0	556.9	647.1	685.3
Strategic programs	(1)	(1)	(1)	1,581.1	1,896.1	1,882.0	2,143.0	2,222.3	2,251.7	2,251.3
Tactical programs	(1)	(1)	(1)	3,019.2	2,936.2	2,811.0	2,923.0	2,895.3	3,715.0	4,357.9
Intelligence and communications	(1)	(1)	(1)	492.6	528.0	664.7	642.9	886.9	1,046.7	1,161.4
Programwide management and support	(1)	(1)	(1)	1,152.1	1,104.1	1,097.2	1,191.5	1,164.3	1,336.9	1,319.0
Other DOD military	300.1	366.5	339.1	361.8	393.7	400.5	429.1	416.7	439.8	423.3
Defense-related atomic energy	666.2	624.4	605.1	590.1	603.8	565.6	620.0	717.1	769.8	826.1
Weapons R&D and testing activities (ERDA)	[2]551.2	[2]502.6	[2]468.8	[2]451.2	[2]454.3	411.5	447.4	528.4	578.3	614.4
Naval reactor development (ERDA)	115.1	121.8	136.3	138.9	149.5	154.1	172.6	188.7	191.5	211.7
Other defense-related activities	.5	1.0	.6	.5	–	–	–	–	–	–
Office of Emergency Preparedness	.5	1.0	.6	.5	–	–	–	–	–	–
Space, total	3,731.7	3,509.9	2,893.0	2,714.3	2,601.3	2,477.6	2,511.3	2,863.2	2,972.4	3,140.0
Manned space flight	2,627.7	2,427.4	1,816.1	1,634.0	1,526.6	1,420.2	1,502.7	1,897.8	2,023.8	2,103.5
Apollo (NASA)	2,080.7	1,679.0	910.0	582.2	71.3	–	–	–	–	–
Space flight operations (NASA)	158.5	332.0	402.6	555.9	815.6	511.3	297.7	188.1	198.6	267.0
Space transportation system operations capability development	–	–	–	–	–	–	3.0	15.5	16.7	80.6
Skylab	141.2	324.6	402.2	534.8	484.6	179.3	–	–	–	–
Apollo-Soyuz Test Project	–	–	–	–	45.0	91.5	109.6	–	–	–
Other	17.3	7.4	18.4	21.1	286.0	240.4	185.1	172.6	181.9	186.4
Space shuttle (NASA)	–	12.5	63.1	63.8	202.0	514.7	794.4	1,202.6	1,314.5	1,345.4
Expendable launch vehicle development and support (NASA)	59.4	69.5	79.6	98.8	119.2	80.4	91.6	165.5	151.0	136.1
Research and program management (NASA)	329.0	334.4	342.8	333.3	318.5	313.8	319.0	341.6	359.7	355.0
Space sciences	372.6	400.5	408.4	554.3	657.4	620.0	567.2	535.4	487.8	519.0
Physics and astronomy (NASA)	150.6	129.2	122.9	117.8	139.1	133.7	150.2	158.9	165.8	223.5
Lunar and planetary exploration (NASA)	103.0	161.9	181.0	313.8	383.7	348.5	281.8	253.5	191.4	157.8
Life sciences (NASA)	39.6	19.4	14.9	17.1	21.2	21.3	19.8	20.5	22.0	33.2
Research and program management (NASA)	79.3	90.1	89.6	105.6	113.4	116.5	115.4	102.5	108.6	104.5
Space technology	407.9	368.2	340.6	236.2	161.4	152.0	154.5	145.6	160.4	188.0
Space nuclear systems (ERDA)	94.8	80.9	74.8	41.8	38.6	26.2	27.2	19.7	20.6	31.7
Space research and technology (NASA)	313.1	287.3	265.8	194.5	122.8	125.8	127.3	125.9	139.8	156.3
Supporting space activities	323.6	313.8	327.9	289.7	255.9	285.5	286.9	284.4	300.4	329.5
Tracking and data acquisition (NASA)	323.6	313.8	327.9	289.7	255.9	285.5	286.9	284.4	300.4	329.5

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Energy development and conversion, total	$327.9	$317.3	$323.6	$382.7	$441.6	$605.1	$1,109.7	$1,387.6	$2,390.4	$2,797.7
Nuclear	305.9	295.9	285.8	334.9	376.5	469.7	674.3	825.2	1,316.4	1,516.9
Laser fusion (ERDA)	([3])	([3])	([3])	([3])	([3])	36.9	45.6	60.7	80.0	101.0
Magnetic fusion (ERDA)	26.5	27.7	28.3	31.0	37.0	53.0	97.9	130.2	183.0	196.9
Liquid metal fast breeder reactor (ERDA)	209.0	194.3	195.6	234.0	256.7	289.6	399.0	347.9	541.9	483.3
Nuclear research and applications (ERDA)								[4]103.9	[4]137.4	[4]156.9
Uranium enrichment-process development (ERDA)	26.1	27.9	26.0	30.7	35.0	45.4	33.3	48.2	68.2	85.7
Fuel cycle research and development (ERDA)							34.0	50.6	168.5	342.5
Applied energy technology (ERDA)	19.7	20.1	13.8	12.6	10.6	([5])	([5])	([5])	([5])	([5])
Nuclear explosion applications (ERDA)	–	–	–	–	–	–	–	–	1.3	1.0
Reactor safety (ERDA)	–	–	–	–	–	–	–	–	28.3	24.0
Reactor safety research (NRC)	24.5	26.0	21.7	26.4	33.9	41.7	60.4	78.2	91.1	111.2
Safeguards research (NRC)	–	–	–	–	–	.6	1.3	3.0	9.6	11.5
Advanced energy conversion (TVA)	–	–	.4	.3	3.4	2.5	2.7	2.5	7.1	3.0
Fossil	19.9	17.7	31.5	35.9	46.6	81.4	269.1	324.0	549.1	549.0
Integrated nonnuclear energy research (OS) (Interior)	–	–	–	–	–	–	1.6	1.0	2.2	1.4
Coal utilization (ERDA)	15.2	12.6	25.6	29.7	40.1	70.2	229.7	284.6	464.9	437.5
Petroleum and natural gas (ERDA)	2.5	2.7	3.0	3.4	3.7	8.1	27.0	23.9	46.3	71.1
In situ technology (ERDA)	2.2	2.4	2.8	2.9	2.9	3.0	10.8	14.5	35.7	39.0
Solar and geothermal	–	–	–	2.4	5.2	19.1	82.8	126.6	313.9	369.6
Solar energy development (ERDA)	–	–	–	1.7	4.0	12.0	54.7	95.9	260.6	284.1
Geothermal energy development (ERDA)	–	–	–	.7	1.1	7.1	28.0	30.7	53.3	85.5
Conservation	2.1	2.4	4.3	8.0	10.3	24.2	64.4	85.8	179.6	337.0
Bonneville Power Administration (Interior)	2.1	1.8	1.9	2.5	2.8	2.4	6.0	7.0	5.8	3.4
Energy conservation (OS) (DOT)	–	–	–	.4	.4	3.3	6.0	5.0	4.6	5.1
Electric energy systems and energy storage (ERDA)	–	.5	2.2	5.1	5.9	14.6	34.3	31.8	55.4	85.1
End use conservation and technologies to improve efficiency (ERDA)							11.6	33.7	91.8	218.2
Energy extension service (ERDA)	–	–	–	–	–	–	–	–	7.5	8.0
Improvement in power systems technology (TVA)	([6])	.1	.2	–	[7]1.2	[7]3.9	[7]6.3	[7]8.3	[7]14.5	[7]17.2
Biothermal research (TVA)	–	–	–	–	–	([6])	.1	–	–	–
Other	–	1.3	2.0	1.4	3.0	10.8	19.1	26.0	31.3	25.2
Federal Energy Administration	–	–	–	–	–	–	1.3	3.0	6.1	–
Energy systems (RANN) (NSF)	–	1.3	2.0	1.4	3.0	3.7	4.5	([8])	([8])	([8])
Energy programs (NASA)	–	–	–	–	–	7.2	13.3	23.0	25.2	25.2
Health, total	1,126.8	1,125.8	1,338.0	1,588.8	1,624.3	2,096.4	2,176.9	2,365.5	2,622.2	2,682.6
Biomedical research	957.5	943.9	1,115.4	1,350.5	1,422.8	1,864.2	1,975.8	2,161.1	2,392.7	2,455.8
Disease control (CDC) (HEW)	16.3	14.6	20.4	16.0	15.5	16.3	13.4	17.8	21.5	19.0
Drugs and devices (FDA) (HEW)	8.0	5.7	7.6	10.3	10.9	14.9	12.5	12.5	14.4	16.0

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Center for Toxicological Research (FDA) (HEW)	–	–	–	–	$5.4	$6.4	$7.6	$9.0	$10.4	$11.5
National Cancer Institute (NIH) (HEW)	$165.7	$166.5	$217.8	$313.5	370.6	522.3	605.0	676.7	728.8	741.7
National Heart, Lung, and Blood Institute (NIH) (HEW)	135.6	135.7	170.6	206.8	226.8	306.9	306.8	346.9	373.5	382.6
National Institute of Arthritis, Metabolism, and Digestive Diseases (NIH) (HEW)	116.8	110.2	116.5	132.0	123.2	157.9	159.5	173.0	199.0	204.7
National Institute of General Medical Sciences (NIH) (HEW)	90.6	83.6	95.8	112.0	104.5	126.9	135.0	144.5	159.4	178.6
National Institute of Neurological and Communicative Disorders and Stroke (NIH) (HEW)	102.9	79.5	85.6	98.7	91.2	124.3	130.0	132.1	147.8	154.4
National Institute of Allergy and Infectious Diseases (NIH) (HEW)	78.5	84.2	89.6	96.2	90.1	111.3	110.7	117.8	132.5	146.6
National Institute of Child Health and Human Development (NIH) (HEW)	57.0	61.3	80.0	101.9	99.3	128.5	130.0	125.8	135.2	146.0
National Institute of Dental Research (NIH) (HEW)	21.9	21.7	28.5	36.4	36.5	40.6	44.2	45.3	50.9	54.6
National Eye Institute (NIH) (HEW)	(9)	18.8	25.2	32.1	29.8	39.2	39.3	45.2	59.1	60.6
National Institute on Aging (NIH) (HEW)	(10)	(10)	(10)	(10)	(10)	(10)	(10)	17.4	27.6	32.4
Division of Research Resources (NIH) (HEW)	79.5	66.1	65.8	74.5	98.6	129.5	126.7	129.9	137.0	101.5
John E. Fogarty International Center (NIH) (HEW)	.2	1.5	2.2	2.5	3.9	5.0	5.7	5.7	8.0	8.4
National Library of Medicine (NIH) (HEW)	4.9	4.2	4.2	5.4	4.5	5.2	5.0	8.5	7.5	7.7
Scientific activities overseas (NIH) (HEW)	7.3	4.5	10.4	3.8	2.5	.9	.5	2.3	5.1	2.4
Office of the Director (NIH) (HEW)	–	6.6	7.1	9.3	9.2	10.8	14.7	16.7	15.6	16.5
Division of Biologics Standards (NIH) (HEW)	6.3	5.6	6.7	5.6	–	–	–	–	–	–
National Institute of Environmental Health Sciences (NIH) (HEW)	13.8	13.3	16.7	22.8	23.6	27.3	32.4	34.9	46.8	56.5
Office of International Health (HEW)	–	–	–	–	.7	2.7	–	–	–	–
Aviation medicine (FAA) (DOT)	2.0	1.9	2.1	2.4	2.8	3.1	2.9	2.5	3.1	3.2
Medical and prosthetic research (VA)	50.2	58.6	62.6	68.4	73.3	84.0	93.8	96.7	109.4	110.8
Mental health	100.6	94.2	99.5	104.7	85.7	108.3	94.3	94.0	108.4	108.0
Mental health (ADAMHA) (HEW)	100.6	94.2	99.5	104.7	85.7	108.3	94.3	94.0	108.4	108.0
Delivery of health care	53.5	70.4	101.8	97.4	66.3	64.7	56.9	64.0	73.5	70.6
Health services research (HRA) (HEW)	41.6	38.3	56.3	56.2	46.9	51.6	37.9	33.1	30.0	31.7
National health statistics (HRA) (HEW)	1.2	1.1	.6	.6	1.8	.6	1.7	2.2	2.0	2.0
Maternal and child health services (HSA) (HEW)	6.2	5.9	5.7	5.9	5.9	5.7	6.6	5.3	5.3	5.3
Family planning services (HSA) (HEW)	–	–	1.1	2.6	2.5	2.5	1.6	2.4	2.5	2.5

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Patient care and special health services (HSA) (HEW)	$2.0	$1.9	$2.0	$2.1	$2.8	$3.2	$2.9	$3.5	$3.8	$3.9
Indian health services (HSA) (HEW)	.6	.6	.7	.8	.8	.9	1.0	1.0	1.0	1.0
Special foreign currency program (HSA) (HEW)	1.9	.5	3.4	1.5	1.2	.1	.8	1.2	4.9	2.2
Emergency medical services (HSA) (HEW)	–	–	–	–	–	–	4.4	4.1	3.9	–
Health and nutrition (OEO)[11]	–	22.2	32.0	27.7	4.4	–	–	–	–	–
Rural health and health care demonstration (SRS)(HEW)	–	–	–	–	–	–	–	11.2	20.1	22.0
Drug abuse prevention and rehabilitation	15.2	17.3	21.3	36.1	49.5	59.2	49.9	46.5	47.6	48.2
Drug abuse program (VA)	–	–	.3	.7	1.0	.8	1.0	1.0	1.0	1.0
Special Action Office for Drug Abuse Prevention	–	–	–	–	12.0	11.1	3.8	–	–	–
Drug abuse research (ADAMHA) (HEW)	10.2	12.1	14.5	27.3	29.6	34.0	34.0	33.8	34.0	34.0
Alcoholism research (ADAMHA) (HEW)	5.0	5.2	6.6	8.1	6.9	13.3	11.1	11.7	12.6	13.2
Environment, total	315.2	354.1	464.6	533.3	651.5	693.0	837.1	899.4	1,100.7	1,098.3
Environmental health and safety	120.0	141.0	152.5	192.1	207.5	229.2	294.3	366.6	426.6	449.2
Human health and safety research (ARS) (USDA)	8.5	9.5	9.8	12.9	15.4	15.6	8.5	9.3	10.2	11.4
National Fire Prevention and Control Administration (Commerce)	–	–	–	–	–	–	3.6	6.4	7.0	6.7
National Institute for Occupational Safety and Health (CDC) (HEW)	15.1	10.7	12.2	19.0	23.0	28.7	29.2	31.8	38.9	40.4
Food safety research (FDA) (HEW)	NA	14.8	12.9	13.6	10.0	13.2	10.3	9.7	11.2	12.4
Radiological products research (FDA) (HEW)	[12] 4.7	[12] 4.2	[12] 4.6	[12] 5.7	3.9	9.0	5.4	5.9	6.8	7.5
Special foreign currency program (FDA) (HEW)	–	.5	.6	.8	–	–	–	–	–	–
Health and safety research (Bu. of Mines) (Interior)	2.2	10.9	20.8	32.3	30.9	30.7	31.9	34.6	35.8	35.6
Occupational Safety and Health Administration (Labor)	.1	.1	.3	.2	.9	1.4	2.0	2.9	3.3	4.3
Materials Transportation Bureau (DOT)	–	–	–	–	–	–	–	–	–	1.0
Consumer Product Safety Commission	–	–	–	–	.3	4.3	6.0	5.6	7.2	6.1
Air quality effects research (EPA)	([13])	([13])	([13])	5.4	10.7	2.1	15.2	14.1	19.3	16.0
Water pollution effects research (EPA)	([13])	([13])	([13])	1.3	.1	([6])	1.1	1.0	2.5	3.8
Pesticides effects research (EPA)	([13])	([13])	([13])	1.8	2.0	2.0	2.5	8.3	8.7	8.0
Radiation effects research (EPA)	([13])	([13])	([13])	1.6	2.0	1.2	1.5	1.6	.9	.9
Interdisciplinary effects research (EPA)	–	–	–	3.9	3.5	3.5	3.2	6.2	5.2	5.4
Water supply effects research (EPA)	–	–	–	–	1.4	2.1	2.9	9.1	13.9	13.0
Toxic substances effects research (EPA)	–	–	–	–	–	–	.6	.8	1.5	1.5
Energy-related environmental effects research (EPA)	–	–	–	–	–	–	13.9	36.7	37.0	34.7
Environmental and fuel cycle research (NRC)	–	–	–	–	–	–	2.5	7.3	13.1	15.4

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Environmental R&D (ERDA)								$135.4	$160.6	$186.0
Life sciences research and biomedical applications (ERDA)	$89.4	$90.3	$91.4	$93.5	$103.4	$115.5	$154.0	39.9	43.5	38.1
Pollution control and environmental protection	80.6	101.0	159.6	166.4	219.3	228.4	302.5	272.3	386.4	350.3
Environmental quality studies (Civil functions) (DOD)	–	–	–	.4	1.9	2.1	2.1	2.7	3.0	3.2
Aquatic plant control research (Civil functions) (DOD)	NA	NA	NA	NA	NA	NA	NA	.9	.8	1.1
Fish protection and fisheries engineering (Civil functions) (DOD)	NA	NA	NA	NA	NA	NA	NA	3.1	2.8	2.9
Dredged material research (Civil functions) (DOD)	–	–	–	–	NA	NA	NA	9.4	5.9	1.9
Environmental and water quality operational studies (Civil functions) (DOD)	–	–	–	–	–	–	–	–	1.7	2.0
Air and noise pollution (FAA) (DOT)	.4	1.2	.1	5.5	5.3	4.5	6.4	4.3	5.2	6.7
Air pollution and environmental protection (FHA) (DOT)	(*)	.2	.3	.8	.9	1.1	1.3	1.0	1.5	1.3
Pollution control and abatement (OS) (DOT)	.7	.5	1.9	12.7	10.1	8.7	4.9	1.3	1.3	2.1
Control of pollution from spillage and waste (CG) (DOT)	.2	1.6	3.2	6.8	7.8	8.1	5.4	5.5	7.1	7.6
Pollution control and abatement (UMTA) (DOT)	–	1.9	3.4	1.1	–	.1	.5	1.3	1.4	1.5
Air quality control (EPA)	[13]32.2	[13]44.1	[13]54.5	48.2	63.6	51.6	47.4	37.7	51.6	41.2
Water quality control (EPA)	[13]33.6	[13]32.1	[13]64.9	45.4	52.3	57.6	49.5	58.3	80.2	68.5
Solid waste management (EPA)	5.5	5.1	10.4	7.7	30.7	7.0	7.9	9.7	9.9	12.5
Pesticides control (EPA)	NA	[13]5.0	[13]5.2	2.2	3.1	7.6	9.2	2.6	6.4	5.6
Radiation protection (EPA)	[13]3.1	[13]2.2	[13]1.7	1.3	.4	1.6	1.1	.1	.3	(*)
Interdisciplinary studies (EPA)	–	–	(*)	3.5	10.1	14.6	19.2	18.7	29.4	22.7
Water supply control (EPA)	–	–	–	–	.7	.8	1.4	1.2	4.4	4.3
Toxic substances research (EPA)	–	–	–	–	–	–	.5	–	1.5	4.3
Energy-related environmental control programs (EPA)	–	–	–	–	–	17.6	80.7	53.0	88.8	68.2
Nuclear materials security and safeguards (ERDA)	2.5	4.4	3.8	3.8	4.0	4.4	6.2	11.8	27.4	37.9
Environmental quality monitoring (NASA)	–	–	–	3.2	3.1	22.4	39.6	31.1	38.5	37.8
Environmental quality (IDOE) (NSF)	–	–	2.3	5.4	4.7	4.9	4.6	4.1	5.5	5.8
Environmental effects of energy (RANN) (NSF)	–	–	–	–	–	1.1	1.2	1.4	–	–
Regional environmental systems (RANN) (NSF)	–	.3	4.3	10.2	11.1	6.1	8.1	6.5	6.0	5.5
Chemical threats to man and environment (RANN) (NSF)	–	.3	1.5	5.0	6.5	6.0	4.9	5.9	5.6	5.6
Regional water quality management (TVA)	1.3	.6	.4	.4	.5	.6	.5	.5	.1	.2
Control of reservoir ecology (TVA)	.3	.4	.4	.5	.5	–	–	–	–	–
Environmental quality projects (TVA)	(*)	.1	.1	.3	–	–	–	–	–	–
Environmental R&D (TVA)	–	–	.2	.2	–	–	–	–	–	–
Air pollution studies (TVA)	.8	1.0	1.0	1.8	2.1	–	–	–	–	–

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Understanding, describing, and predicting the environment	$114.6	$112.1	$152.5	$174.7	$224.6	$235.3	$240.0	$260.5	$287.7	$298.8
Fire and atmospheric science research (FS) (USDA)	3.1	3.5	3.7	4.9	7.0	7.5	8.1	8.1	8.7	8.8
Environment programs (NOAA) (Commerce)	23.0	27.2	44.3	49.9	46.2	47.3	52.3	53.8	56.3	56.9
Basic environmental services (NOAA) (Commerce)	(1)	(1)	(1)	21.7	23.2	19.2	24.8	22.8	23.1	24.6
Public forecast and warning services (NOAA) (Commerce)	(1)	(1)	(1)	6.1	6.6	6.6	8.2	8.1	9.4	9.2
Specialized environmental services (NOAA) (Commerce)	(1)	(1)	(1)	5.3	3.5	3.0	3.4	4.0	4.2	4.5
Weather modification (NOAA) (Commerce)	(1)	(1)	(1)	5.0	4.2	6.1	6.2	5.9	7.3	5.3
Environmental data and information service (NOAA) (Commerce)	(1)	(1)	(1)	1.5	1.2	1.7	2.6	2.8	1.5	1.5
Global monitoring of climatic change (NOAA) (Commerce)	(1)	(1)	(1)	.2	.4	.6	2.1	1.8	1.8	1.9
Mapping, charting, and surveying services (NOAA) (Commerce)	(1)	(1)	(1)	4.8	4.4	6.9	4.3	4.5	4.4	6.1
Maritime technology (NOAA) (Commerce)	(1)	(1)	(1)	5.4	2.8	3.1	.9	3.8	4.8	3.9
Marine ecosystems investigations (NOAA) (Commerce)	–	–	–	–	3.7	4.7	5.2	6.9	8.1	9.4
International projects (NOAA) (Commerce)	NA	.8	.6	4.4	5.8	8.5	6.4	7.9	8.0	6.5
Environmental satellite services (NOAA) (Commerce)	2.9	3.1	3.0	3.0	2.9	4.4	5.1	5.1	5.8	8.1
Mapping of earthquake geologic hazards and earthquake prediction (GS) (Interior)	1.2	1.4	1.5	1.8	5.6	7.7	11.0	12.3	11.7	28.0
Aviation weather (FAA) (DOT)	.5	.8	.6	2.2	1.5	2.2	1.8	2.3	5.2	5.2
Earth dynamics monitoring and forecasting (NASA)	73.4	59.8	65.7	5.6	11.8	22.7	16.8	11.4	7.0	10.9
Ocean condition monitoring and forecasting (NASA)							23.4	31.6	43.5	26.4
Weather and climate observation and forecasting (NASA)				62.3	86.5	81.1	60.9	57.7	51.9	42.1
International Biological Program (NSF)	.8	4.0	7.5	9.5	9.2	(14)	(14)	(14)	(14)	(14)
Global Atmospheric Research Program (NSF)	.5	1.5	1.9	2.4	3.3	3.2	4.2	4.1	4.8	5.4
Climate dynamics (NSF)	–	–	–	–	–	–	1.0	2.1	4.3	4.7
Environmental forecasting (IDOE) (NSF)	–	–	7.1	7.8	6.1	3.5	5.3	6.4	5.5	6.6
Arctic Research Program (NSF)	–	–	1.9	3.5	3.0	3.7	3.2	3.6	4.8	5.3
U.S. Antarctic Research Program (NSF)	6.9	7.4	7.8	8.7	19.7	24.5	25.1	32.1	47.1	49.0
Weather modification (RANN) (NSF)	2.4	2.6	3.4	4.5	5.2	3.9	4.0	4.8	4.3	2.7
Earthquake engineering (RANN) (NSF)	–	–	1.0	3.2	5.1	8.4	5.6	7.6	9.4	21.3
Fire research (RANN) (NSF)	–	–	2.6	1.1	1.8	1.7	.7	1.3	–	–

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Social response to natural hazards (RANN) (NSF)	–	–	–	–	–	–	$ .3	$1.2	$1.3	$1.6
Science and technology base, total	$513.4	$524.6	$523.8	$601.2	$604.7	$694.6	781.6	839.2	952.6	1,059.9
Basis for national physical measurement system (NBS) (Commerce)	16.4	18.0	14.6	15.6	15.8	18.1	18.9	20.2	23.0	21.3
Special foreign currency program (NBS) (Commerce)	–	–	–	–	–	–	–	(*)	.1	.2
Patent and Trademark Office (Commerce)	.4	.4	.6	.6	.6	.5	.5	.4	.4	.4
Library of Congress	1.8	1.9	2.5	2.3	2.6	2.2	2.6	3.0	3.1	3.4
High-energy physics (ERDA)	118.6	120.5	118.5	116.4	122.6	125.8	136.2	154.0	170.0	188.0
Nuclear physics (ERDA)	128.5	129.6	124.0	117.4	117.7	127.0	155.5	54.6	64.9	68.4
Basic energy sciences (ERDA)								112.9	128.9	147.1
Sustaining university program (NASA)	8.9	7.7	–	–	–	–	–	–	–	–
Materials processing in space (NASA)	–	–	–	–	–	4.3	6.5	8.3	12.6	21.3
Mathematical sciences research project support (NSF)	12.7	12.7	12.9	13.9	14.3	15.3	17.2	18.2	21.2	23.4
Computer research project support (NSF)	11.4	13.0	9.9	12.5	9.4	10.3	12.3	13.9	15.7	17.3
Physics research project support (NSF)	25.7	23.8	25.5	32.7	33.4	38.7	44.1	47.9	56.7	61.8
Chemistry research project support (NSF)	17.8	17.4	19.6	23.1	21.3	28.1	34.2	31.5	36.2	39.9
Engineering research project support (NSF)	16.0	16.7	14.1	25.1	25.0	29.6	35.8	37.6	41.7	44.5
Materials research project support (NSF)	7.8	7.7	11.1	33.3	31.9	37.5	45.5	48.5	53.9	58.8
Astronomy research project support (NSF)	6.8	5.8	6.7	7.8	8.2	9.8	10.0	10.4	12.9	14.6
Atmospheric sciences research project support (NSF)	8.2	7.9	9.4	11.5	11.5	12.9	14.4	15.2	19.1	20.3
Earth sciences research project support (NSF)	7.9	7.8	8.1	9.5	9.1	11.6	13.5	16.4	17.0	21.2
Oceanography research project support (NSF)	11.0	8.9	10.0	12.6	12.1	14.1	15.9	16.7	18.9	20.6
Physiology, cellular and molecular biology research project support (NSF)	27.6	28.0	26.6	34.5	27.2	38.4	43.7	46.7	54.6	62.6
Behavioral and neural sciences research project support (NSF)	8.2	8.8	13.0	15.1	14.4	17.5	19.3	21.1	25.1	30.0
Environmental biology research project support (NSF)	7.0	8.6	8.5	10.3	17.6	22.9	27.2	28.6	32.6	35.7
Social sciences research project support (NSF)	10.8	10.9	13.0	16.6	16.7	19.1	18.8	20.0	22.9	25.5
Oceanographic facilities operations support (NSF)	8.6	7.4	8.2	9.6	10.0	14.6	16.3	15.9	18.5	17.8
Solar eclipse support (NSF)	–	–	–	.1	.7	(*)	(*)	.1	–	–
Ocean sediment coring program (NSF)	2.4	6.6	7.1	9.1	9.7	11.7	[1]12.3	12.7	13.8	14.2
Science information activities (NSF)	6.4	7.0	7.0	7.5	9.4	7.9	5.4	6.1	5.3	5.3
National Astronomy and Ionosphere Center (NSF)	–	1.4	2.3	3.0	2.8	3.4	3.3	4.1	4.0	5.9
Kitt Peak National Observatory (NSF)	5.6	6.4	7.1	7.3	6.2	8.2	7.2	8.0	8.2	8.7
Cerro-Tololo Inter-American Observatory (NSF)	1.2	1.5	2.0	2.1	2.0	2.4	2.5	3.3	3.2	3.5
National Radio Astronomy Observatory (NSF)	7.3	5.1	6.8	6.5	6.1	7.5	5.8	5.7	6.5	9.7

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
National Center for Atmospheric Research (NSF)	$10.4	$11.2	$14.0	$17.2	$14.3	$18.4	$18.2	$19.2	$20.3	$23.9
Sacramento Peak Observatory (NSF)	–	–	–	–	–	–	–	–	.7	1.4
Exploratory research and technology assessment (RANN) (NSF)	–	1.0	1.4	1.2	.7	1.2	1.3	1.5	1.5	2.2
Science Assessment, Policy, and Planning (NSF)	1.0	.7	1.3	1.8	3.6	6.4	10.2	7.9	5.3	5.3
Special foreign currency program (NSF)	–	–	1.0	1.9	3.5	4.4	2.2	3.2	3.3	3.9
Office of Science and Technology	1.8	1.9	2.0	2.0	–	–	–	–	–	–
Basic research support (Smithsonian)	14.8	18.2	15.1	21.3	24.0	24.7	24.8	25.7	30.6	32.1
Transportation and communications, total	458.1	590.2	778.7	614.6	630.1	702.9	640.5	635.7	768.8	804.8
Air	315.8	406.3	553.5	316.5	307.1	416.1	395.3	406.3	445.1	490.1
Civil supersonic aircraft (DOT)	93.8	160.5	264.0	–	–	–	–	–	–	–
Civil Aeronautics Board	.2	.3	.3	.3	.3	.4	.4	.4	.5	.5
Aeronautical research and technology (NASA)	178.3	193.4	209.9	225.4	237.0	300.5	300.4	316.9	340.5	381.4
Air traffic control (FAA) (DOT)	25.9	29.7	51.8	49.3	37.0	39.3	39.7	41.1	59.0	67.9
Navigation (FAA) (DOT)	4.3	4.7	11.0	11.5	16.5	26.3	18.6	23.0	15.4	10.7
Other air transportation R&D (FAA) (DOT)	13.2	17.7	16.6	30.0	16.4	49.6	36.2	24.8	29.7	29.6
Ground	70.3	81.7	110.5	153.8	179.0	192.2	157.0	155.9	231.6	218.2
Federal Highway Administration (DOT)[16]	29.2	32.6	26.5	19.9	22.7	39.7	43.4	27.9	52.9	53.1
Railroad research (FRA) (DOT)	.2	.4	1.2	8.3	35.5	33.5	32.4	50.4	61.7	44.2
High speed ground transportation R&D (FRA) (DOT)	11.5	11.2	20.4	18.1						
National Highway Traffic Safety Administration (DOT)	10.9	19.5	26.7	50.0	54.6	53.6	34.0	31.4	58.9	51.3
Urban Mass Transportation Administration (DOT)[16]	18.5	18.1	35.6	57.6	66.2	65.4	47.2	46.2	58.1	69.6
Water	24.6	29.4	39.1	45.8	43.7	36.5	33.3	25.9	33.0	30.7
Maritime Administration (Commerce)	8.1	12.5	20.7	22.2	23.8	23.1	22.9	19.0	17.9	16.4
Coast Guard (DOT)[16]	16.5	16.8	18.4	23.6	19.9	13.4	10.4	6.9	15.2	14.4
Multimodal	4.1	8.5	13.4	10.5	13.1	17.8	20.4	19.5	27.2	24.0
Office of the Secretary (DOT)[17]	4.1	8.5	13.4	10.5	13.1	17.8	20.4	19.5	27.2	24.0
Communications	43.2	64.3	62.3	88.1	87.2	40.3	34.5	28.1	31.8	41.8
Office of Telecommunications (Commerce)	–	–	2.1	3.6	3.5	1.6	1.3	.9	1.0	1.0
Federal Communications Commission	.9	1.0	.6	.7	1.1	.9	1.1	1.5	2.1	2.1
Office of Telecommunications Policy	–	–	.2	1.2	.6	.3	4.1	4.6	3.5	3.9
U.S. Information Agency	.1	.2	.1	.1	.1	.1	.1	.1	.1	.1
Space communications (NASA)	42.3	63.1	59.3	81.0	79.8	36.3	24.8	18.5	21.9	31.4
Telecommunications (RANN) (NSF)	–	–	–	1.6	2.0	1.1	3.0	2.5	3.2	3.2

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Natural resources, total	$201.0	$237.5	$326.0	$354.0	$341.0	$340.8	$444.6	$488.8	$546.9	$609.8
Mineral	42.0	47.1	54.0	54.6	60.2	76.0	152.4	181.6	198.7	193.7
Metallurgy research (Bu. Mines) (Interior)	11.3	12.2	13.1	13.7	15.2	15.8	17.8	24.9	25.3	25.4
Mining research (Bu. Mines) (Interior)	7.4	8.0	8.9	5.7	6.4	12.9	50.5	63.3	72.4	69.0
Mined land demonstration (Bu. Mines) (Interior)	–	–	1.3	2.8	4.6	5.3	6.0	7.0	10.1	4.1
Other mineral resources programs (Bu. Mines) (Interior)	3.1	3.3	2.1	1.8	1.4	1.4	1.4	1.5	1.6	1.8
National petroleum reserve in Alaska (GS) (Interior)	–	–	–	–	–	–	–	–	1.0	–
Geologic and mineral resources surveys (GS) (Interior)	19.7	22.8	22.6	25.2	27.8	34.5	70.0	71.1	78.0	80.7
Conservation of lands and minerals (GS) (Interior)	.6	.7	.7	1.8	1.9	2.6	3.7	5.4	5.8	7.4
Seabed assessment (IDOE) (NSF)	–	–	5.3	3.7	2.9	3.5	3.1	3.2	3.6	4.3
Advanced processing technology (RANN) (NSF)	–	–	–	–	–	–	–	5.2	.9	1.0
Water	64.9	69.6	73.6	79.9	73.1	61.8	63.6	64.8	70.7	78.6
Watershed management research (FS) (USDA)	3.9	4.3	4.6	6.3	6.6	6.7	8.7	7.8	8.0	8.5
Coastal engineering R&D studies (Civil functions) (DOD)	9.3	9.5	8.6	10.6	3.3	3.4	3.4	3.5	3.7	5.1
Materials research (Civil functions) (DOD)					1.7	1.9	1.9	1.7	1.9	2.2
Flood control and navigation R&D (Civil functions) (DOD)					1.8	3.1	2.5	2.8	3.1	4.5
Water resources planning studies (Civil functions) (DOD)					1.3	.8	1.5	1.6	1.4	3.2
Streambank erosion control (Civil functions) (DOD)	–	–	–	–	–	–	–	–	.2	.7
Bureau of Reclamation (Interior)	7.2	7.3	9.2	10.2	9.7	7.4	7.8	8.3	10.3	9.0
Water resources investigations (GS) (Interior)	11.4	13.3	14.4	14.5	15.0	16.1	18.2	20.1	22.5	24.2
Saline water R&D (OWRT) (Interior)	22.0	24.1	24.0	24.6	20.1	9.5	19.5	19.0	19.5	21.1
Water resources research (OWRT) (Interior)	10.7	10.8	12.4	13.4	13.3	12.8				
Soil-water relationship (TVA)	.2	.2	.2	.2	.1	–	–	–	–	–
Water control investigations (TVA)	.1	.2	.1	.1	–	–	–	–	–	–
Land	24.3	27.3	31.8	40.8	47.4	47.1	59.3	59.8	69.3	74.6
Cooperative forestry research (CSRS) (USDA)	3.4	3.9	4.7	5.0	4.9	6.2	7.1	7.5	8.2	8.2
Timber management research (FS) (USDA)	9.0	9.8	10.6	12.8	13.0	14.3	16.0	16.[illegible]	16.8	16.6
Forest insect and disease research (FS) (USDA)	6.2	7.2	7.4	[illegible].2	9.5	10.7	17.3	18.2	19.8	20.0
Forest resource evaluation (FS) (USDA)	2.3	2.5	3.2	3.4	3.5	3.7	4.1	5.3	9.4	13.2
Special foreign currency program (FS) (USDA)	.4	.6	.5	–	–	–	–	–	–	–
Surface environment and mining R&D (FS) (USDA)	–	–	–	–	–	1.8	2.2	2.3	2.6	2.6
Bureau of Land Management (Interior)	.7	.7	.8	.8	.7	.7	.8	.7	.9	1.4

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Alaska-pipeline-related investigation (GS) (Interior)	$ .6	$ .7	$1.3	$1.4	$1.2	$ .9	$ .3	$ .3	$ .3	$ .3
Land information and analysis (GS) (Interior)	.9	1.1	2.5	7.4	13.8	7.2	9.6	8.4	9.8	10.2
Forest and wildland resource R&D (TVA)	.7	.7	.8	.8	.3	–	–	–	–	–
Improvement and establishment of wildland vegetation (TVA)	–	–	–	–	.3	.3	.4	–	–	–
Biomass utilization (RANN) (NSF)	–	–	–	–	–	1.3	1.5	.9	1.4	2.2
Recreation	25.5	24.0	28.5	28.3	30.3	33.0	35.6	34.2	39.4	45.2
Wildlife, range, and fish habitat research (FS) (USDA)	2.7	2.7	2.8	3.6	3.5	4.6	4.9	4.9	6.5	6.9
Forest recreation research (FS) (USDA)	.8	.9	.9	1.1	1.2	1.5	1.5	1.3	1.6	2.1
Bureau of Outdoor Recreation (Interior)	.2	.1	.2	(*)	(*)	(*)	(*)	(*)	(*)	(*)
National Park Service (Interior)	2.6	–	1.1	1.3	1.5	2.5	8.4	9.3	9.9	11.8
Habitat preservation (Interior)	11.4	12.0	14.3	12.5	2.8	3.1	3.9	4.2	5.1	6.2
Wildlife resources (FWS) (Interior)					6.2	8.5	9.8	8.4	9.3	10.2
Fishery resources (FWS) (Interior)					5.7	5.7	6.8	5.6	6.6	7.3
Federal aid in fish restoration and management (FWS) (Interior)	2.9	3.1	3.5	3.8	3.6	3.0	.2	.1	.1	.1
Federal aid in wildlife restoration (FWS) (Interior)	4.6	4.9	5.3	5.5	5.4	4.0	.1	(*)	.1	.1
Fisheries resource assessment (TVA)	.3	.3	.4	.3	.2	.2	.2	.3	.4	.4
Multiresource	44.3	69.6	138.1	150.4	130.0	122.9	133.7	148.4	168.8	217.7
Research on use and improvement of soil, water, and air (ARS) (USDA)	20.4	21.6	25.9	28.8	30.9	32.2	25.7	29.0	33.5	37.8
Sea Grant program (NOAA) (Commerce)	4.0	5.7	11.5	18.4	20.8	15.1	15.5	15.1	17.8	17.8
Earth resources R&D (Civil functions) (DOD)	–	–	–	–	–	–	–	–	–	.5
Topographic surveys and mapping (GS) (Interior)	.9	1.0	1.1	1.1	.9	1.3	1.6	1.6	1.7	1.7
Special foreign currency program (OS) (Interior)	–	–	–	.5	.5	.5	.1	.1	2.7	1.0
Living resources (IDOE) (NSF)	–	–	.3	.9	2.1	2.6	2.0	2.3	3.2	2.9
General support (IDOE) (NSF)	–	–	–	–	–	–	.4	.5	.8	.8
Resource systems (RANN) (NSF)	–	–	–	–	–	–	.2	3.4	3.2	3.2
Resource conservation (RANN) (NSF)	–	–	–	–	–	–	–	2.1	.7	.7
Earth resources detection and monitoring (NASA)	19.1	41.3	99.2	100.8	74.8	71.1	84.5	86.0	92.1	133.2
Applications explorer missions (NASA)	–	–	–	–	–	–	3.7	8.3	13.2	18.1
Food, fiber, and other agricultural products, total	225.0	240.6	246.9	290.7	296.9	291.0	348.5	388.3	444.0	488.3
Production	171.5	180.3	190.1	233.3	241.5	234.0	276.5	310.0	360.7	397.6

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Research on animal production (ARS) (USDA)	$74.5	$80.9	$93.5	$102.4	$33.1	$34.7	$41.2	$47.1	$53.8	$59.3
Research on plant production (ARS) (USDA)					67.2	68.8	77.3	87.7	101.5	117.6
Food and nutrition research (ARS) (USDA)					6.4	6.5	7.6	8.9	13.3	14.8
Special foreign currency program (ARS) (USDA)	5.7	4.9	4.8	8.6	8.6	7.3	6.6	7.1	8.3	7.5
Agricultural research under the Hatch Act (CSRS) (USDA)	51.5	55.5	61.7	65.2	69.1	70.2	77.3	84.9	99.3	107.4
Agricultural research under the Morrill Act (CSRS) (USDA)	3.3	1.6	1.4	12.4	15.4	11.5	15.2	19.5	19.7	19.2
Ocean fisheries and living marine resources (NOAA) (Commerce)	31.9	32.7	23.6	39.5	36.1	29.0	43.5	46.3	51.8	57.1
Innovative biosynthesis techniques (RANN) (NSF)	–	–	–	–	–	–	1.0	.5	2.2	2.2
Nonconventional protein (RANN) (NSF)	–	–	–	–	–	.4	.3	1.0	1.2	2.0
Agricultural projects (TVA)	.2	.2	.3	.3	.3	.2	.2	.1	.1	.2
Fertilizer development (TVA)	4.3	4.5	4.8	4.9	5.3	5.5	6.2	6.9	9.4	10.2
Marketing and distribution	52.5	59.4	55.8	56.4	54.4	56.2	70.8	76.4	81.2	88.6
Marketing efficiency (ARS) (USDA)	38.5	43.6	39.2	39.3	34.0	34.5	46.1	48.7	50.9	55.7
Expansion of agricultural exports (ARS) (USDA)					1.8	1.8	1.8	2.1	2.2	2.4
Consumer services (ARS) (USDA)					.4	.4	.4	.5	.6	.6
Economic Research Service (USDA)	13.2	14.9	15.5	16.0	16.9	18.1	21.3	24.0	26.2	28.3
Farmer Cooperative Service (USDA)	.8	.9	1.0	1.1	1.2	1.4	1.2	1.2	1.3	1.6
Other	1.0	.9	1.1	1.0	1.0	.8	1.2	1.9	2.1	2.1
National Agricultural Library (USDA)	.4	.2	.4	.2	.3	.1	(*)	(*)	–	–
Statistical Reporting Service (USDA)	.6	.7	.7	.7	.7	.6	1.2	1.9	2.1	2.1
Education, total	154.8	146.6	186.1	190.7	214.2	173.5	149.1	142.4	283.8	269.2
Bureau of Health Manpower (HRA) (HEW)	11.9	10.1	16.3	17.8	4.0	3.6	3.8	2.9	5.0	–
National Institute of Education (HEW)	84.1	78.4	75.6	64.2	118.5	75.7	69.9	63.7	85.7	104.0
Office of the Assistant Secretary for Education (HEW)	–	–	–	–	–	–	.6	1.0	1.0	1.0
Occupational, Vocational, and Adult Education (OE) (HEW)	–	.9	53.4	56.6	43.0	40.3	34.9	35.0	154.5	127.9
Education for the handicapped (OE) (HEW)	15.5	15.3	14.2	14.3	13.7	9.9	9.6	16.2	10.9	10.9
Higher education (OE) (HEW)	2.5	1.9	.8	1.0	1.1	1.0	1.1	.9	1.2	1.2
Other education (OE) (HEW)				.2	.5	.4	.2	.5	.3	.5
Special projects (OE) (HEW)	–	–	–	–	–	–	–	5.5	7.9	9.6
Head Start (OHD) (HEW)	4.4	4.5	7.5	4.7	14.2	6.7	6.3	5.1	5.1	5.1
Institutional grants for research management improvement (NSF)	–	–	–	–	.3	.2	–	–	–	–
Institutional science development (NSF)	24.3	16.6	5.3	5.3	–	–	–	–	–	–
Institutional grants for science (NSF)	–	8.0	4.3	7.1	3.7	2.7	–	–	–	–

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Science education development and research (NSF)	$12.1	$11.0	$8.8	$19.5	$15.3	$33.0	$22.8	$11.5	$12.3	$9.0
Income security and social services, total	96.7	105.6	127.8	125.2	157.2	133.8	148.5	133.4	155.9	148.0
Native American programs (OHD) (HEW)	–	–	–	–	–	–	–	.6	.4	.7
Child abuse (OHD) (HEW)	–	–	–	–	–	–	11.5	12.7	11.5	11.6
Child development research and demonstration (OHD) (HEW)	3.6	4.8	12.3	17.3	16.7	16.0	15.0	15.3	15.4	15.5
Programs for the aging (OHD) (HEW)	4.2	3.3	2.8	9.0	11.5	7.4	7.2	4.3	8.9	7.4
Rehabilitation services and facilities (OHD) (HEW)	28.1	27.4	22.7	28.9	21.8	21.1	21.0	21.7	30.4	30.6
Special foreign currency program (OHD) (HEW)	–	–	–	–	–	1.8	2.5	1.9	5.3	–
Youth development (OHD) (HEW)	–	–	–	–	–	–	.8	.3	1.0	1.1
Experiments, demonstrations, and related analysis (OS) (HEW)	[18]15.8	[18]26.5	[18]41.9	[18]21.7	[18]51.2	20.2	17.3	17.0	15.3	15.4
Analytical studies and activities (OS) (HEW)						7.9	7.3	5.0	3.1	5.3
Institute for Research on Poverty (OS) (HEW)						1.6	1.6	1.7	1.6	1.8
Public assistance research and evaluation (SRS) (HEW)	12.5	4.2	8.6	5.8	9.2	8.9	9.6	7.4	9.2	9.2
Social security research (SSA) (HEW)	7.3	12.4	10.9	13.6	18.5	19.4	22.6	9.1	9.6	12.2
Health insurance experiments and demonstrations (SSA) (HEW)								5.3	10.5	10.6
Employment Standards Administration (Labor)	1.9	2.1	1.5	1.6	1.3	.9	3.2	4.3	5.5	5.6
Employment and Training Administration (Labor)	21.0	20.5	21.7	19.6	17.9	16.1	15.5	17.5	19.2	17.3
Civil Service Commission	.2	.4	.6	1.0	2.4	3.1	4.4	4.0	3.8	3.8
Legal services (CSA)	2.1	4.0	4.9	6.6	6.7	5.0	[19]	[19]	[19]	[19]
Research and demonstration (CSA)	–	–	–	–	–	4.4	8.9	5.2	5.0	–
Area and community development, housing, and public services, total	49.4	91.1	88.7	87.4	96.7	96.4	101.8	104.2	110.5	99.2
Housing research (ARS) (USDA)	.2	.2	.3	.2	.2	.2	.2	.4	.3	.4
Rural development pilot research (CSRS) (USDA)	–	–	–	–	–	1.5	1.5	1.5	1.5	1.5
Economic Development Administration (Commerce)	5.3	8.8	4.6	6.6	6.3	4.1	10.3	15.1	14.6	4.5
Office of Minority Business Enterprise (Commerce)	–	–	–	.5	2.1	1.0	4.6	2.0	2.0	1.6
Department of Housing and Urban Development	21.0	42.7	59.6	58.2	61.7	64.8	62.0	67.6	62.7	67.7
Housing assistance research	[20]	[20]	[20]	[20]	[20]	[20]	[20]	18.1	13.6	14.0
Housing safety and standards research	[20]	[20]	[20]	[20]	[20]	[20]	[20]	6.4	5.0	4.9
Housing economic data and analyses	[20]	[20]	[20]	[20]	[20]	[20]	[20]	10.4	10.8	12.1
Consumer and equal opportunity research	[20]	[20]	[20]	[20]	[20]	[20]	[20]	4.1	4.6	5.0
Community conservation research	[20]	[20]	[20]	[20]	[20]	[20]	[20]	6.4	8.0	8.3
Community development research	[20]	[20]	[20]	[20]	[20]	[20]	[20]	9.0	6.0	7.2

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Energy conservation and standards research	([20])	([20])	([20])	([20])	([20])	([20])	([20])	$4.2	$3.9	$4.1
Program evaluation	([20])	([20])	([20])	([20])	([20])	([20])	([20])	1.3	1.9	2.5
Research program support and utilization	([20])	([20])	([20])	([20])	([20])	([20])	([20])	1.5	1.5	1.9
Administrative expenses	([20])	([20])	([20])	([20])	([20])	([20])	([20])	6.3	7.3	7.7
Advisory Commission on Intergovernmental Relations	$ .4	$ .6	$ .5	$ .7	$ .9	$1.1	$1.2	1.0	1.2	1.4
Appalachian Regional Commission	–	–	3.0	–	–	–	–	.7	.8	.8
Community development (CSA)	22.0	36.2	17.9	12.7	15.5	12.3	14.2	5.0	14.0	8.8
Program evaluation (CSA)	–	–	–	–	–	–	–	–	–	1.0
Federal Home Loan Bank Board	.3	.4	.4	.5	.5	.7	.7	.8	1.0	1.0
Service delivery technology and systems (RANN) (NSF)	–	–	–	–	2.0	2.3	2.4	3.6	2.0	1.5
Service productivity and intergovernmental relations (RANN) (NSF)	–	1.8	1.6	6.9	2.8	4.2	2.6	2.9	3.2	3.2
Intergovernmental science program (RANN) (NSF)	.2	.5	.8	1.1	4.6	4.3	2.0	3.6	7.3	5.9
Economic growth and productivity, total	55.8	80.0	98.9	62.8	75.1	71.9	67.1	83.9	98.1	96.8
Forest products utilization research (FS) (USDA)	7.0	7.6	8.3	9.0	8.9	9.3	9.9	10.4	11.8	11.9
Forest engineering research (FS) (USDA)	.8	.9	.9	1.4	1.5	1.7	1.6	1.6	1.6	1.6
Forest economics and marketing research (FS) (USDA)	2.7	2.9	3.2	3.3	3.6	3.7	3.9	3.8	4.1	4.2
Services to improve use of materials (NBS) (Commerce)	5.3	5.7	9.9	10.4	12.8	12.3	14.1	16.0	18.1	17.4
Services to improve the application of technology (NBS) (Commerce)	4.4	4.9	6.2	6.7	5.8	7.4	7.1	7.1	8.0	6.7
Improvement of computer technology applications (NBS) (Commerce)	.9	1.0	1.9	2.1	2.4	2.4	3.1	4.1	4.7	4.7
Bureau of the Census (Commerce)	5.4	6.5	4.1	3.9	1.0	1.0	1.0	2.5	2.7	2.8
U.S. Travel Service (Commerce)	–	–	–	–	.8	–	–	–	–	–
Bureau of Labor Statistics (Labor)	3.8	3.8	3.8	4.8	1.0	1.7	1.8	1.3	1.4	1.2
Labor Management Services Administration (Labor)	.1	.3	.5	.7	.9	1.2	.8	.7	2.9	3.0
Office of the Secretary (Labor)	–	–	.2	.2	1.2	2.5	2.0	1.8	2.3	1.9
Bureau of Engraving and Printing (Treasury)	.6	.6	.8	1.3	1.0	1.1	1.7	2.8	2.8	2.9
Federal Trade Commission	.5	.4	.4	.6	.7	.9	.9	.9	1.1	1.2
General Services Administration	.3	.3	.2	.3	.5	1.8	1.8	1.1	1.4	2.3
Technology utilization (NASA)	4.4	5.6	5.6	6.4	5.2	5.2	6.4	10.4	11.7	11.7
Advanced industrial processing (RANN) (NSF)	–	–	6.0	5.3	8.1	5.5	4.8	6.7	5.1	5.1
Regulation (RANN) (NSF)	–	–	–	–	–	.9	.9	4.1	4.1	4.1
National productivity measurement (RANN) (NSF)	–	–	2.8	2.5	6.1	2.6	1.2	2.0	1.5	1.5
Distribution and equity (RANN) (NSF)	–	.8	4.3	4.0	5.1	2.9	2.8	3.3	5.1	5.1
Industrial program (RANN) (NSF)	–	–	–	–	8.5	7.7	1.0	1.6	1.6	1.6
Mineral market behavior (RANN) (NSF)	–	–	–	–	–	–	.2	.2	1.1	1.0
Systems analysis (RANN) (NSF)	–	–	–	–	–	–	–	–	.4	.8

(See footnotes at end of table.)

Federal R&D obligations by function, subfunction, and agency program: fiscal years 1969-78 — Con.

[Dollars in millions]

Function, subfunction, and agency program	Actual								Estimates	
	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Postal Service	$19.4	$38.7	$39.7	–	–	–	–	–	–	–
Small Business Administration	.2	.1	–	–	–	–	$ .2	$ .1	$1.0	$1.1
U.S. International Trade Commission	–	–	–	–	–	–	–	1.5	2.8	2.8
Interstate Commerce Commission	–	–	–	–	–	–	–	.1	.6	.4
International cooperation and development, total	26.8	32.2	32.3	$29.5	$32.9	$26.7	29.8	44.5	53.3	70.8
Departmental funds (State)	.1	.1	.4	.6	1.5	1.5	1.2	1.6	1.6	2.3
Agency for International Development (State)	19.5	27.3	29.7	26.0	24.7	21.1	26.7	37.8	44.6	60.3
Action	.8	.1	.1	–	–	.2	.2	.1	.3	.3
U.S. Arms Control and Disarmament Agency	6.0	4.2	1.7	1.9	2.0	1.1	1.0	1.4	2.4	2.6
International cooperative scientific activities (NSF)	.5	.4	.5	1.0	4.7	2.9	.7	3.6	4.4	5.3
Crime prevention and control, total	4.8	8.6	10.3	25.0	34.8	36.3	45.9	36.3	48.9	44.4
R&D on eradication of narcotic-producing plants (ARS) (USDA)	–	–	–	1.6	1.6	1.6	1.6	1.4	1.4	1.4
Drug Enforcement Administration (Justice)	.6	.8	1.5	1.2	1.6	5.0	1.5	2.5	6.5	3.3
Drug control (LEAA) (Justice)	–	–	.7	1.2	4.2	6.3	10.4	[21] 1.1	([21])	([21])
Bureau of Prisons (Justice)	.2	.2	.4	.5	.5	.5	.6	.8	1.3	2.0
Federal Bureau of Investigation (Justice)	.3	.2	1.0	.7	.7	1.9	1.2	1.2	1.4	1.8
Law Enforcement Assistance Administration excluding narcotics control (Justice)	3.7	7.4	6.8	19.8	26.2	21.0	30.5	28.2	35.0	29.5
Courts: Court facilities, personnel and treatment	([1])	([1])	([1])	2.0	2.3	1.1	3.1	1.1	2.3	2.2
Crime prevention: Laboratory techniques	([1])	([1])	([1])	1.2	5.3	2.3	1.7	3.9	2.1	2.2
Police: Crime detection and prevention methodology	([1])	([1])	([1])	3.5	3.0	.8	2.0	1.3	2.4	2.2
Equipment systems improvement	([1])	([1])	([1])	9.6	6.3	8.1	.9	9.3	3.1	1.3
Corrections	([1])	([1])	([1])	3.5	4.1	1.6	3.2	1.3	2.9	2.2
Juvenile delinquency							2.8	3.1	6.7	7.5
Cooperative research	–	–	–	–	5.3	4.5	3.7	3.1	5.1	2.2
Technology transfer	–	–	–	–	–	1.2	6.6	2.1	5.7	5.0
Evaluation	–	–	–	–	–	1.3	6.6	3.0	4.6	4.7
Immigration and Naturalization Service (Justice)	–	–	–	–	–	–	.1	.1	.8	.4
Office of the Attorney General (Justice)	–	–	–	–	–	–	–	–	–	2.0
Bureau of Alcohol, Tobacco, and Firearms (Treasury)	–	–	–	–	–	–	–	–	1.3	2.3
U.S. Customs Service (Treasury)	–	–	–	–	–	–	–	1.0	1.2	1.6

[1] Detail not available prior to 1972.
[2] Includes laser fusion prior to 1974.
[3] Laser fusion R&D was included in weapons R&D and testing activities prior to 1974.
[4] This total excludes the part of this program that is applicable to space nuclear systems shown within the space function.
[5] This program was redistributed among various other ERDA programs under the new agency structure.
[6] Less than $50,000.
[7] Contribution to the Electric Power Research Institute for research related to the electric utility industry in general.
[8] This program was transferred to ERDA and is currently conducted as a non-R&D activity.
[9] National Eye Institute included in National Institute of Neurological Disease; and Stroke.
[10] National Institute on Aging included in National Institute of Child Health and Human Development.
[11] The OEO health and nutrition program was transferred in 1974 to HEW, and the R&D activities under this program were thereafter continued.
[12] Radiological products research includes small amounts for general product safety research.
[13] Environmental health portion of EPA programs cannot be separately identified prior to 1972 and is included under pollution control and environmental protection for the years 1969-71.
[14] Transferred to NSF environmental biology project support.
[15] Include: foreign funds.
[16] Excludes pollution control and environmental protection programs.
[17] Excludes pollution control, environmental protection, and energy conservation programs.
[18] A group of poverty programs of OEO was transferred to OS (HEW) in 1974 and continued under the activities shown. The total for 1973 also includes an income maintenance program transferred from SRS (HEW).
[19] Transferred to the Legal Services Corporation, which was authorized in 1975 as a public corporation but not as a Federal agency.
[20] Detail not available prior to 1976.
[21] The drug control program was scheduled for funding under block grants to the States with no known R&D component.

Source: National Science Foundation.

Other Science Resources Publications

REPORTS	NSF No.	Price
Research and Development in Industry, 1975. Funds, 1975; Scientists & Engineers, January 1976	77-324	In press
Graduate Science Education: Student Support and Postdoctorals, Fall 1975	77-313	$2.20
Detailed Statistical Tables, Fall 1976	77-319	—
Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1975	77-311	$2.20
Detailed Statistical Tables, Fiscal Year 1976	77-325	—
Characteristics of Doctoral Scientists and Engineers in the United States, 1975	77-309	$3.00
Manpower Resources for Scientific Activities at Universities and Colleges, January 1976	77-308	$2.00
Detailed Statistical Tables, January 1977	77-321	—
Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1975	77-307	$2.00
Detailed Statistical Tables, Fiscal Year 1976	77-316	—
Women and Minorities in Science and Engineering	77-304	$0.75
Characteristics of the National Sample of Scientists and Engineers		
Part 1. Demographic and Educational	75-333	$1.90
Part 2. Employment	76-323	$2.80
Part 3. Geographic	76-330	$2.00
U. S. Scientists and Engineers, 1974	76-329	$1.25
1985 R&D Funding Projections	76-314	$2.10
Projections of Degrees and Enrollment in Science and Engineering Fields to 1985	76-301	$1.15
The 1972 Scientist and Engineer Population Redefined		
Volume 1. Demographic, Educational, and Professional Characteristics	75-313	$3.70
Volume 2. Labor Force and Employment Characteristics	75-327	$2.65
Detailed Statistical Tables. Engineers, by Field	76-306	—
Research and Development in State Government Agencies, Fiscal Years 1972 and 1973	75-303	$1.80
Young and Senior Science and Engineering Faculty, 1974: Support, Research Participation, and Tenure	75-302	$1.70
Projections of Science and Engineering Doctorate Supply and Utilization, 1980 and 1985	75-301	$1.30
REVIEWS OF DATA ON SCIENCE RESOURCES		
No. 29. "Current and Future Utilization of Scientific and Technical Personnel in Energy-Related Activities"	77-315	$0.60
No. 28. "Scientists and Engineers From Abroad. Trends of the Past Decade, 1966-75"	77-305	$0.35
No. 27. "Education and Work Activities of Federal Scientific and Technical Personnel, January 1974"	76-308	$0.40
No. 26. "Energy and Energy-Related R&D Activities of Federal Installations and Federally Funded Research and Development Centers. Funds, FY 1973-75 (est.) and Manpower, Jan. 1973-75 (est.)	76-304	$0.35
No. 23. "R&D Expenditures of State Public Institutions, Fiscal Year 1973"	75-311	$0.35
SCIENCE RESOURCES STUDIES HIGHLIGHTS		
"National Sample of Scientists and Engineers: Changes in Employment, 1972-74 and 1974-76"	77-322	—
"Aptitude Test Scores of Prospective Graduate Students in Science Remained Essentially the Same From 1970 to 1975"	77-318	—
"Academic R&D Expenditures Up 9 Percent in FY 1976"	77-314	—
"Private Industry Employment of Scientists and Engineers in 1975 Shows 5-Year Decline"	77-312	—
"Graduate Science and Engineering Enrollment Up Only 1 Percent in 1976"	77-302	—